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No. 18.
BIOLOGICAL SERIES No. 6.

ADDITIONAL NOTES
TO
Summer Birds of Flathead Lake,
WITH SPECIAL REFERENCE TO
SWAN LAKE

BY
PERLEY MILTON SILLOWAY,
Principal Fergus County Free High School, Member American Ornithologists' Union,
Author of "Some Common Birds," "Summer Birds of Flathead Lake," Etc.

WITH INTRODUCTION BY MORTON J. ELROD.

PREPARED AT THE UNIVERSITY OF MONTANA BIOLOGICAL STATION, BIGFORK, MONT.,
UNDER DIRECTION OF MORTON JOHN ELROD.

University of Montana, Missoula, Montana, U. S. A.
1903.

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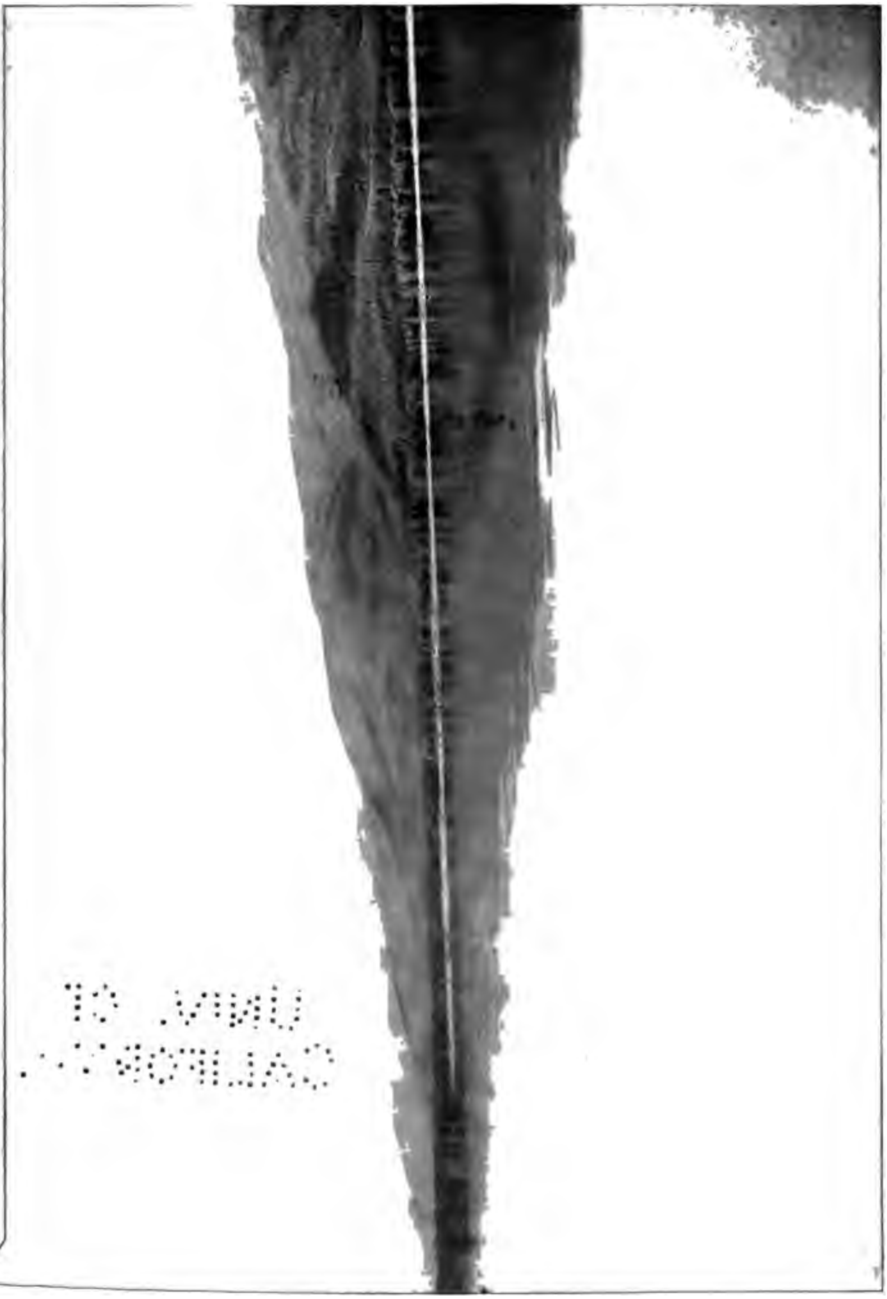

Upper end of Swan Lake, showing the swampy shore and wooded slopes of Mission Range. Photo in July by M. J. Elrod. View is S. W.

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Introduction.

The notes presented in this bulletin, when added to the bulletin "Summer Birds of Flathead Lake," University of Montana Biological Series No. 1, include the work on ornithology during the summers of 1900, 1901, 1902 and 1903. Three seasons having been spent in the Mission Mountains, on the Flathead Indian Reservation, and along the shores of Flathead lake, it was thought best to extend the observations in the summer of 1903. Prin. Silloway was therefore recommended to spend a portion of the time in the vicinity of Swan lake.

This lake is a beautiful sheet of water, cradled between two ranges of mountains, with wooded slopes to the water's edge. It is primitively wild, with miles of woodland, interspersed occasionally with open glades.

Only a few hardy pioneers have entered the region. The birds have thus not been molested by man, and a visit to the region gave opportunity for study not heretofore made.

The illustrations here given are as faithful a portrayal of the region about Swan lake as can be made with the camera. Plate LIII shows the region to the southeast, with the Mission range in the background. The mountain slopes to the low summits are covered with a dense forest. Bordering the lake may be seen a fringe of willows, back of which are the cottonwoods and alders, and lastly the conifers. A large area bordering the water is swampy, shown in Plates LIV and LV. It is exceedingly difficult to get around in this region. Plate LVI shows the location of the lake with regard to the mountains, while Plate LVII shows a large portion of the wooded valley south of and above the lake. With the exception of a section of country including the lower portion of the lake as shown in Plate LV all of the country shown in the photographs is in the Lewis and Clarke forest reserve.

The notes here presented by Prin. Silloway contain several important features worthy of special mention. One point is the calamity that often befalls the old birds or the young. Another is the fact that birds occupy unfinished nests, which contain eggs. This latter may be due to the laziness or shiftlessness on the part of the mother, or to her inexperience, which prevents rapid working, or to the destruction of a first nest. The finding of a nest of the Willow thrush, which ordinarily builds close to the ground, six and one-half feet up in a tree, will be of interest to students of animal intelligence, as illustrating the change of habit due to environment. The region overflows annually. Irregular habits of nidification were also found in the cedar waxwing. Indeed, the notes so carefully prepared show quite plainly great individuality in the construction of the nests.

Since Bulletin Biological Series No. 1, Summer Birds of Flathead Lake, is out of print it is considered advisable to print a list of the summer birds thus far discovered, which is appended. This list therefore includes all the summer birds which have been observed about Flathead lake, numbering *137.*

MORTON J. ELROD.

Missoula, Mont., Sept. 19, 1903.

610354

Further Notes on the Summer Birds of Flathead Lake.

The following notes are based upon observations made from May 30 to July 30, 1902. The first three weeks of June were spent at the head of Swan lake; the remainder of the time was given to observation in the immediate vicinity of the Biological Station. As a supplement to the notes made during the seasons of 1900 and 1901, which were reported in the bulletin entitled "The Summer Birds of Flathead Lake," issued under the direction of the University of Montana Biological Station, these further notes are deemed worthy of publication. Several important species, overlooked in the previous seasons, were noted in 1902; and as a complete record of our observations for the region is desirable, the notes herein given will serve to fill out somewhat that which was lacking in the larger bulletin. As previously stated, no attempt has been made to furnish a complete list of the birds of the Flathead region, but simply to report such observations as were made by our party during the collecting season; hence no authorities have been cited. It is merely intended to furnish a record of personal work that may be helpful to other observers.

SWAN LAKE.

Among the many little lakes which lend interest and beauty to the Mission, Swan, and other ranges of our Montana mountains, Swan lake is worthy of consideration because of many delightful features. It is an expansion of Swan river, or the Big Fork, the outlet of the lake into the river being about eight miles overland from the Biological Station, in a direction somewhat south of east. A very poor road, generally overflowed during the time of high water in the spring, but tolerably passable at other times, leads from the Station to the foot of the lake. Another road, generally in ordinary condition, follows a course around the bend of Swan river to the northward, thus furnishing access to the lake at all times, the distance over this road being about fifteen miles.

In its origin the lake bed is probably the result of glacial action, whereby in remote ages an irregular furrow was ploughed by the moving ice-mass. The situation is between the northern end of the Mission range and the southern end of the Swan range, and nearly parallel to the eastern shore of Flathead lake. From the tops of the Mission summits between the two lakes, both can be easily seen, the separating crests being not more than five or six miles in breadth.

Swan lake is said to be about twelve miles in length, and the average width is at least half a mile. The contour of the lake is formed by several successive slightly cresentic bays or enlargements. At its head it opens out into a nearly circular area about two miles in diameter, above which lies a large submerged region in the spring, though later it becomes a meadow covered with a rank growth of coarse grass. The western side of the lake is bounded by gradual slopes of the dwindling Mission mountains, presenting vast areas of evergreen forest, part of which is in the domain of the Lewis and Clarke forest reserve. On the eastern side of the lake are the rugged, fire-swept, or rocky heights of the Swan range, rising quite abruptly from the water's edge.

The swampy area at the head of Swan lake was the scene of most of our activities during the first three weeks of June. At that time it was covered with dead water from two to four feet in depth most of the new growth not having yet appeared above the water. Here and there were patches of old reeds, browned and tangled, with a few green reeds struggling toward the light. In this swamp we found holboell's grebe in a small colony. American golden-eyes were leading forth their broods for their first practice on the water; a few yellow-headed blackbirds were hoarsely piping in the reeds. Overhead a pair of bald-headed eagles, the male a magnificent specimen with regal white head and snowy tail, soared or flapped lazily from range to range, seeming not to care to molest the industrious ospreys that used this most convenient fishing-ground. Now and then a sora could be startled from its haunts in the reeds, or a marsh wren would amuse us with its squeaky songs. Mallards were regularly feeding in the grass; while occasionally the booming of the American bittern announced its presence in the bog.

The forested margin of the lake was populous with birds. In the twilight depths the varied thrush flitted here and there; frequently a black-headed jay uttered his harsh warning, and watched the observer from a treetop. Pheasants, the gray ruffed grouse, were nesting commonly in the neighborhood. About our cabin Cassin's purple finch was a regular visitor. Indeed, it is certain that no other portion of the Flathead lake region is tenanted by a greater number of species than the swampy area and the immediate neighborhood of Swan lake, and to make special mention of any inhabitants of the locality would serve only to mislead the reader regarding the occurrence of others.

Oological Notes.

Of several species, quite common throughout the Flathead region, no nests were met with in the seasons of 1900 and 1901. Notes made concerning such as were found nesting in 1902 may be of interest, though little new or unusual was observed in the nidification thus described.

A nest of the western robin, **Merula migratoria propinqua**, was found on May 31, at Polson. It was in a low crotch of a haw tree, and contained three eggs. Thinking that the set was incomplete, I visited the nest on the following morning to note progress, when I found only two eggs in the nest. It was evident that some marauder had despoiled the home of part of its contents. I was unable to follow the fate of the nest, but it is likely that on a future occasion, when the owner returned to her nest after an outing, she found it empty. Last season I noted a similar occurrence in the history of a nest of Wright's flycatcher, **Empidonax wrightii.** Each successive day the set showed a decrease of one egg, until finally only the empty nest remained. It would be interesting to know the particular despoiler of each of these wildwood homes.

In view of the extended notes given concerning the nidification of the olive-backed thrush, **Turdus ustulatus swainsonii**, in the larger bulletin, it may seem superfluous to add anything of like nature in these pages. However, the following may not be out of place. A deserted nest of olive-backed thrush was found on July 6, containing two eggs. The site was an upright crotch of a small fir, perhaps the lowest in my observation, the brim of the nest being not more than three feet from the ground.

Deserted nests of this thrush are chanced upon quite frequently. One fell under my notice on July 9, on the Helena club grounds near the road. It was in an upright crotch of a dead oblique fir, about seven feet from the ground. It was a very bulky nest, the walls averaging one and one-fourth inches in thickness. They were made of coarse dried grass, lichen, skeleton leaves, and punky material, the unfinished interior being mainly of skeleton leaves. This nest contained four eggs, rather advanced in incubation.

In several instances I have observed the olive-backed thrush sitting in the unfinished, empty nest. On July 6, I noticed a female sitting in a nest of which the foundation was scarcely laid. Apparently she was not working on the nest, shaping it to her form, but sitting quietly as if incubating. On July 19, I inspected this nest, and then it contained three eggs advanced in incubation. Once before this season I noticed a female sitting in her unfinished nest. It is worth mentioning that on both these occasions the day was showery, and the weather may have influenced the bird in its action.

As in each of the two preceding seasons, one nest of the willow thrush, **Turdus fuscescens salicicola**, was found, and the different site it occupied makes it worthy of mention. It was in the swampy area west of the Station grounds, bordering the harbor. Instead of being situated near the ground, it was six and one-half feet above, in an upright crotch of an oblique thorny sapling. The nest was typical of the willow thrush in construction, but the site was so unusual in my experience that I collected the owner for complete identification. It was a bulky structure, made of coarse weed-stems, pine needles, and bark, lined with fine black rootlets. A large piece of green leaf, which had probably fallen into the nest, had been incorporated into the lining. The cavity averaged two and three-fourths inches in diameter, two inches deep. The eggs were unspotted, of the greenish-blue color characteristic of this species.

One nest of the long-tailed chickadee, **Parus atricapillus septentrionalis**, was found. It was at the head of Swan lake, on June 6, at which date the eggs were about ready to hatch. The site was an old cavity made by a small woodpecker or the owner, in an old decayed birch stump in the swampy margin of the lake. The nest was a soft bed of rabbit fur. There were seven eggs in the nest.

On July 1, a nest of Parkman's wren, **Troglodytes aedon parkmanii**, was examined. It was on the tract known as the "Big Burn," on the Mission slopes southeast of the Station, in a cavity made by a woodpecker in a decayed stump. The nest was made of dead twigs for a foundation, weed-fibers, soft feathers, and pieces of sloughed snake skin. There were two fresh eggs in this nest.

The catbird, **Galeoscoptes carolinensis**, nests very commonly in the region about Daphnia Pond. On July 7, I found my first nest of this species containing five eggs. One of these was infertile, and the others were quite advanced in incubation. The catbird prolongs its nesting season, though later sets of eggs contain less than the regular complement of four of earlier nesting. On July 16, we noted a nest containing three eggs, and on July 22 another nest was found with three eggs. All of these nests were in the low buckbrush growing so plentifully on the ridges near the Station.

A nest of the cedar waxwing, **Ampelis cedrorum**, seemed to indicate irregular habits of nidification of this species. The nest was noticed on June 27. It was situated in a fir in the edge of the Station grounds, near the top of the tree and about twelve feet from the ground. It was made on horizontal branches, against the main stem, from which site it was removed when first noticed, examined, and replaced to wait for later examination. It then contained three eggs. On June 30, it contained four eggs. On July 1, when the eggs were further examined, three of them were incubated very noticeably beyond the fourth, a condition showing that the eggs were not deposited on successive days, or that the three eggs had been incubated several days longer than the fourth.

The western vesper sparrow, **Poocaetes gramineus confinis**, nests abnudantly near the shore of Flathead lake. In the meadow opposite to the store at Polson, five nests were found, and another nest was noted just outside the fence, in the bushes bordering the lake. On May 31, a nest was taken from a depression at the base of a grass tuft. It was made of coarse dried grass and horsehair. Cavity two and three-eighths inches in diameter, depth one and one-half inches. The depression was on the shady and darkest side of the grass tuft. There were four eggs, fresh. The eggs of this sparrow are pale greenish-white, irregularly marked with spots of reddish-brown. On May 30, a nest of the western vesper sparrow was found in a depression at the base of a little bush, beside a path between the meadow and the lake. It contained three eggs, which were somewhat incubated. Another nest noted on May 31 with three eggs, on June 2, contained only two eggs. Another examined on June 2, contained one youngling just hatched, one egg breaking for the struggling occupant, and two eggs. Another nest noted on June 2, held four fresh eggs; another held four fresh eggs, and still another contained three eggs far advanced in incubation. All of these nests were made after a common plan of structure, and were on the darkest side of the tufts under which they were placed, a characteristic not usually noticeable in the sites of most of the ground-nesting species, and indeed not generally characteristic of the vesper sparrow.

Brewer's blackbird, **Scoleophagus cyanocephalus**, was commonly nesting in the low bushes near the lake shore at Polson. On May 31, a nest of this species was taken from a bush in a clump. The site was twelve inches from the ground, among upright stems. The nest was made of coarse weed-stems and twigs, with muddy material in the walls, and a bedding of horsehair. The cavity was three and three-fourths inches across, and two and three-fourths inches deep. This nest contained six eggs, partially incubated. A second nest contained three eggs of the owner and one of the cowbird. The eggs of Brewer's blackbird are dark greenish-white, variously marked with blotches of dark brown.

At Selish, a nest of the western meadowlark, **Sturnella magna neglecta**, was observed on the hillside back of the hotel. It was made in typical manner, of coarse dried grass, in a tuft of tangled dead and green grass, well arched at the top. There were five eggs, partially incubated. They were very handsomely marked, having large, bold blotches of reddish brown on a snowy background.

Traill's flycatcher, **Empidonax traillii**, has been mentioned as nesting throughout this region. On July 8, a nest of this flycatcher was found in a small fir in the edge of the Station grounds, within arm's reach of a path leading down into the swampy area. It was placed upright on horizontal twigs beside the main stem, six feet from the ground. When first noticed it contained three younglings about ready to leave the nest. In structure the nest is much like that of the yellow warbler, **Dendroica aestiva**, or that of Wright's flycatcher, **Empidonax wrightii**, being made of strippings of weed-stems, grass stems, and bits of gossamer. On July 6, after a cold rain of a week's duration, a nest of Traill's flycatcher was noticed containing three young birds about half fledged, dead, doubtless from exposure.

A nest of the western wood pewee, **Contopus richardsonii**, was noticed near the Station on July 8. It was in an aspen on the lake shore, saddled upon a dead branch at a fork about three feet from the main stem, and about fifteen feet from the water below. In attempting to examine it, I accidentally spilled the four eggs, and the nest dropped into the water and was almost immediately disintegrated. The eggs were found to be far advanced in incubation. Another nest of this species was noted on July 17, in a large fir tree on the shore of the lake near the Station. It was about fifteen feet from the ground, near the extremity of a large dead horizontal branch, the site being at least ten feet from the trunk of the tree. As in the former instance, the nest was made upon a horizontal fork. Fearing that the accident in the former case might repeat itself, we did not attefpt to examine this nest, and left the female sitting contentedly upon her breezy home. The eggs of the western wood pewee are creamy yellowish-brown, blotched irregularly with reddish-brown.

The western nighthawk, **Chordeiles virginianus henryi**, nests abundantly on the rocky ridges near the Station. A set of two eggs of this nighthawk was found June 26, on the rocky ridge west of the road leading to Holt. The sitting bird was startled within three feet of me as I ascended the rock. She flitted painfully away for about twenty feet, and sat fluttering for several minutes; then she flutered over the edge of the cliff and disappeared. The eggs were on a portion of bare rock surrounded by brown moss, the bare spot being not more than three inches square. The eggs were advanced in incubation. They are a dark stone gray, variously marked with spots and blotches of dark brown. On July 1, I chanced upon a sitting nighthawk on the rocks east of Daphnia Pond. Upon being flushed, she flew away low and heavily. Only one egg was found, far advanced in incubation, and I fancied that the parent bird had carried away an egg or a young recently hatched. The egg was on the bare rock or earth which scantily covered the rock, though a few small sprouts were growing near. On July 19, a set of two fresh eggs was found on these rocks.

Several nests of the gray ruffed grouse, **Bonasa umbellus umbelloides**, were examined. One found on June 7, at the head of Swan lake, was made about eight feet from a trail used frequently by trappers. It was under the upturned end of a fallen log, in warm exposure, made of dead leaves in a depression, with half a dozen soft feathers. The depression measured seven inches across at the top, and was two and one-half inches deep. There were ten eggs, partialy incubated. They are a light reddish-cream color, having few faint indistinct specks of reddish-brown. On June 15, a nest of this grouse was noted with six eggs. It was at the base of a small fir, made as before described, and like the other, it was near a trail and not closely concealed. On June 20, the nest was empty, the eggs having evidently hatched, and the place was deserted. Another nest of the ruffed grouse was found on June 16, in the edge of a small clearing on Swan lake. This nest was under the edge of a fallen log, among surrounding tangled weeds that most effectually concealed the nest. It held seven eggs which were thought to be about ready to hatch.

A small colony of Holboell's grebe, **Colymbus holboellii**, consisting of at least five pairs, was found nesting at the head of Swan lake. The first nest was found on June 4, among tall dead reeds. It was made of black decaying material, with some green reeds intermingled. The mass floated about four inches above water. The nest was in the edge of a clump of reeds, about which there was clear water all around. There were five eggs, loosely covered with material similar to that of the nest. The eggs were partially incubated, and had acquired the browned, baked appearance peculiar to eggs of the grebes after lying some time in the nest. On June 7, a second nest of this grebe was found, situated in bushes on overflowed ground. It was made as usual of decaying material, with which some green reeds in short pieces were intermingled. This nest was founded on coarse dead twigs, probably brought up from the ground below. These eggs were also covered with material like that in the nest, the four eggs being somewhat advanced in incubation. Nest No. 3 was noted on June 17, with five eggs, uncovered, and quite fresh. They were of a pale greenish-white color, not having changed to the appearance described in a foregoing account. This nest was made as usual, anchored in the edge of old reeds. It is worth while to state that on June 12, this nest held two eggs, on June 14, three, and June 17, five. A fourth nest was noted June 17, with three eggs about half incubated. On June 18, another nest of Holboell's grebe was examined, which was in the willow bushes in the edge of the overflow area. It was made on depressed branches, a large strong nest, twenty-four inches across at the surface of the water, rising four inches above the water, with a cavity seven and one-half inches across, one and one-half inches deep. This nest was made as the others, of old reeds with some new material on top. There were four eggs, incubation far advanced. On June 20, a set of three eggs was found in a large nest anchored in the edge of a small clump of reeds, the eggs being partially incubated. The last nest of this series was examined June 20, and contained four fresh eggs, It was a large mass of dried decaying material anchored among thick reeds, with two opposite approaches through the reeds to open water. The eggs were not covered, but being fresh were of the bluish-white tinge.

On July 4, 1903, a nest of the Louisiana tanager was found in a tall fir tree in front of the Biological Station building. The birds were observed to frequent the place, and by close watching the female was seen to take her place upon the nest. It was about twenty-five feet from the ground, on a dwarf branch among others which were the lowest bearing vegetation. The site was a horizontal fork, and the nest was held in place by surrounding twigs. It was made outwardly of coarse forky twigs, the walls being chiefly made of fine rootlets, and there was a lining of horsehair. The cavity was two and three-fourths inches in diameter, and one and one-half inches deep. When the nest was collected the female was sitting, and she remained on the nest until I had nearly reached the branch. The tuft of twigs in which the nest was made was about four feet from the main stem. There were four eggs, about one-half incubated. They are pale bluish green, with specks of blackish brown distributed sparsely over the surface. When removed from its site, the loose twigs in the outer part of the nest fell away like that part of a grosbeak's nest.

On July 15, a nest of Townsend's warbler, **Dendroica townsendi**, was found in a clump of small firs on a rocky ridge of the Helena club grounds. The site was unusually low, being only six feet from the ground in a small fir surrounded by larger ones. The nest could be seen only by a person pushing his way into the clump. It was made beside the main stem, situated like a chipping sparrow's nest, which it greatly resembled. It was made externally of coarse weed-stems and grasses, with a lining of fine grasses and horsehair. The cavity was two inches in diameter, and one and three-eighths inches deep. The nest contained five young which were nearly fledged, showing the black crown and yellow superciliary line, and wing-bands. All the young were infested with a parasitic grub, which had eaten a hole in the skull and neck; it appeared that the brain had been entirely destroyed by the wriggling occupants of the cavity, though the younglings were apparently enjoying life and were eagerly stretching forth their mouths at the approach of the parents. The male seemed most active in bringing in supplies, and he was collected with little difficulty. The female was shyer, and only by considerable waiting and watching was the collector able to secure her.

On July 6, 1903, a nest of the ruby-crowned kinglet, **Regulus calendula**, was collected, with both parent birds. This nest was along a road through the Helena club grounds. It was situated about fifteen feet from the ground, near the extremity of a branch of a medium-sized fir tree. The site was six feet from the main stem. The nest was partially saddled on an oblique twig on the under side of the branch, and was also somewhat pendent from several smaller twigs about which the walls were woven. The nest was four inches in diameter externally, and three inches deep. The opening was two and one-fourth inches across, and the cavity was one and seven-eighths inches deep. The nest walls were made of dark green lichens common in the tamarack forest, deer hair, gossamer, and shreds of bark. The lining was made of hair, soft downy feathers, and lichen. There were eight young in the nest, ready to leave in two or three days at most.

Notes on New Birds.

167. Ruddy Duck, **Erismatura jamaicensis** (Gmel.)

This handsome little duck was met with in the summer of 1901, on a small pot-hole on the Flathead reservation. The watery area was about an acre in extent, margined by a thick growth of grass. As we passed it somewhat hurriedly, we noticed several ducks on the water. Loitering behind the others, I made a circuit of the pond, and at one place I came upon a wounded duck crouching in the grass, almost under my feet. Before I could capture it, the duck revived and swam out into the deeper water. However, I could not fail to recognize the reddish-chestnut of the back, and the black of the head, nor the little tail left so jauntily erect. Indeed, I was stooping to pick up the duck when it glided away from my reach. It is likely that several pairs of this duck were nesting on the little pond where they were seen.

206. Sandhill Crane, **Grus mexicana** (Mull.)

The sandhill crane was observed in both the seasons of 1901 and 1902. In the former summer, on July 29, a pair of these cranes was observed standing on a stranded tree near the mouth of Flathead river. I tried to secure a specimen with the shotgun, but the great birds paid no attention to my No. 6 shot. These birds lingered near the mouth of the river for several days, but they were too wary to be taken. In 1902, when we were encamped at the head of Swan lake, July 26, a sandhill crane flew overhead, circling somewhat uneasily about the place, and finally alighted in the meadow, but was not thereafter observed.

221. American Coot, **Fulica americana** Gmel.

The American coot eluded our notice until the spring of 1902, when it was observed in the swamp at the head of Swan Lake. On the morning of June 6, two individuals were seen feeding, and as they paid little attention to our quiet movements in a skiff, we watched them for some time with considerable interest. Hoping that they might be nesting in the swamp, I refrained from taking a specimen at that time. However, they were not seen again, and there was no evidence of their nesting there. We were told by trappers in the neighborhood that the coots assembled in the swamp in the fall in hundreds.

225. American Avocet. **Recurvirostra americana.**

The American avocet was not noted in the Flathead region until 1903, when a single specimen was observed on August 11, at the mouth of Flathead river. It was feeding on the sand-bar in company with several Baird's sandpipers and some ring-billed gulls. An effort was made to secure it, but it flew away with a broken leg and we were unable to capture it. However, there can be no doubt regarding the indentification, as the species is well-known to me from previous observation.

357. Piegon Hawk, **Falco columbarius** Linn.

A fine specimen of pegion hawk was taken on the Station grounds on July 19. It flew into one of the trees soon after sunset, moving restlessly from one tree to another until my attention was directed to it. My first impression was that it was a sparrow hawk, but thinking best to secure it, I caught it by a lucky shot as it was leaving the grounds. It presented the following measurements: length, 11.15 inches; wing, 7.80 inches; tarsur, 1.30 inches; culmen to cere, .50 inch; tail, 5 inches; middle toe to claw, 1.15 inches; extent of wings, 23 inches. Iris, brown; cere, tarsi, and feet, yellow; mandible, greenish-yellow basally, bluish horn at tip. The specimen proved to be a male, and was in splendid plumage in almost perfect coloration.

358. Richardson's Merlin, **Falco richardsonii** Ridg.

A male of this species was taken at the head of Swan lake on July 26. It was apparently a young of the year, as the rusty markings predominated in its plumage. The specimen presented the following approximate measurements: length, 12.50 inches; wing, 8.60 inches; tail, 5.75 inches; tarsi, 1.35 inches; culmen to cere, .55 inches; middle toe to claw, 1.32 inches.

379. Pygmy Owl, **Glaucidium gnoma** Wagl.

This interesting little owl occurs regularly throughout the wooded parts of the Flathead lake region, but it eluded our notice until 1902. During the protracted rains of the first week of July, we were kept generally indoors, but in an afternoon walk between showers, Mr. Ricker saw a specimen of this owl near the Station and described it very accurately to me. It was not until July 17, that it chanced under my observation, when three specimens were taken from a family which was taking an afternoon outing along the road through the woods south of the bridge at Bigfork. One of the owls was sitting in a small tamarack beside the road, almost within reach of passing teamsters. When it was shot, the others flew from perches nearby, and alighted in the largest trees not far away. They perched in each instance on horizontal branches close to the main trunk. When flushed, they uttered a faint shrill whistling call. One of the family, the female in charge of the youngsters, uttered a low cooing whistle, in low pitch.

It was reported to me that specimens of tne pygmy owl were at Kalispell. Mr. Ernest Bond also told me that this owl was frequently taken at the head of Swan lake. (It is also found at Missoula. M. J. E.)

497. Yellow-headed Blackbird. **Xanthocephalus xanthocephalus.**

This species was found sparingly in the swamp at the head of Swan lake, the first being noted June 7, when both males and females were seen. Thereafter specimens were seen every day that we visited the swamp, until June 21, during which time the males were in song. As far as I could observe, there were no nests in the swamp. No specimens were taken, as I did not wish to interfere with the nesting of this species by sacrificing the lives of any of the colony.

675a. Grinnell's Water-Thrush. **Seiurus noveboracensis notabilis.**

This water-thrush was heard regularly in the swampy woods at the head of Swan lake, singing cheerily from the tangled bushes, but it managed to elude capture until July 10, 1903, when it was still in song. It was also heard in the swamp-woods near the mouth of Swan river. There is no doubt that Grinnell's water-thrush breeds in suitable localities in the Flathead region.

725c. Western Marsh Wren. **Cistothorus palustris plesius** Ober.

A specimen of this wren was taken in the marsh at the head of Swan lake, July 26. It was singing vigorously, and near it an unfinished nest was found, the only evidence of its nesting.

763. Varied Thrush. **Ixoreus naevius** (Gmel.)

The varied thrush was found to be common at the head of Swan lake, where it flitted in the dark forest of the mountain-sides. An old nest was brought to me, containing fragments of shells easily indentifiable. The nest was made like one of the olive-backed thrush, outwardly of twigs and lichens, lined with soft whitish fibers. It is reported to nest very early. The trappers in the neighborhood, and the person who brought me the nest, asserted that this species is a winter resident as well in this region.

List of Birds.

List of the Summer Birds of Flathead lake, including those given in the former bulletin and those added by the present bulletin.

1. Colymbus holboellii. Holboel's Grebe. A small colony found breeding at the head of Swan lake, 1902.

2. Colymbus nigricollis californicus. American Eared Grebe. Young reared in Sinyaleamin lake, Missoin Mts., 1901. Also at Rost lake.

3. Urinator imber. Loon. Common, breeds.

4. Urinator lumme. Red-throated Loon. Specimens taken at Flathead lake and at Rost lake, 1901.

5. Larus occidentalis (?). Western Gull. One specimen, doubtfully identified, taken at the mouth of Flathead river.

6. Larus delawarensis. Ring-billed Gull. Common at Flathead lake.

7. Sterna forsteri. Forster's Tern. One specimen taken from a small flock, Aug. 23.

8. Merganser americanus. American Merganser. Noted regularly after Aug. 23, 1901.

9. Lophodytes cucullatus. Hooded Merganser. A female taken July 15, 1901, at Rost lake.

10. Anas boschas. Mallard. Common, breeds.

11. Nettion carolinensis. Green-winged Teal. Common after the middle of August.

12. Dafila acuta. Pintail. Common, breeds.

13. Aix sponsa. Wood Duck. A male young-of-the-year taken July 31, 1901, from a small flock.

14. Clangula clangula americana. American Golden-eye. The commonest of the breeding ducks of the region, seen on every little body of water.

15. Charionetta albeola. Buffle-head. Not common, breeds.

16. Erismatura jamaicensis. Ruddy Duck. Found breeding on the pot-holes of the reservation.

17. Branta canadensis. Canada Goose. Common, breeds.

18. Botaurus lentiginosus. American Bittern. Common, breeds.

19. Grus mexicana. Sandhill Crane. A pair seen July 29, 1901, at the mouth of Flathead river.

20. Porzana carolina. Sora. Common, breeds.

21. Fulica americana. American Coot. Seen only at the head of Swan lake early in June, 1902.

22. *Phalaopus* lobatus. Northern Phalarope. A specimen taken on *Flathead lake August* 27, 1900.

23. Gallinago delicata. Wilson's Snipe. Common after the middle of July.

24. Tringa bairdii. Baird's Sandpiper. Occurs regularly after the middle of August.

25. Calidris arenaria. Sanderling. Common toward the end of August.

26. Totanus melanoleucus. Greater Yellowlegs. Common.

27. Totanus flavipes. Yellow-legs. Common.

28. Helodromus solitarius. Solitary Sandpiper. Occurs regularly toward the end of July and thereafter.

29. Bartramia longicauda. Bartramian Sandpiper. Occurs locally, breeds.

30. Actitis macularia. Spotted Sandpiper. Abundant, breeds.

31. Numenius longirostris. Long-billed Curlew. Common, breeds.

32. Aegialitis vocifera. Killdeer. Common, breeds.

33. Colius virginianus. Bob-white. Introduced, increasing between Bigfork and Kalispell.

34. Dendragapus ogscurus richardsonii. Richardson's Grouse. Occurs in the mountains near the lake.

35. Dendragapus franklinii. Franklin's Grouse. Occurs in the higher mountains.

36. Bonasa umbellus umbelloides. Gray Ruffed Grouse. Abundant.

37. Pedioecetes phasianellus columbianus. Columbian Sharp-tailed Grouse. Abundant in the open prairie regions.

38. Zenaidura macroura. Mourning Dove. Occurs regularly, but not numerous, breeds.

39. Circus hudsonius. Marsh hawk. Common at the foot of Flathead lake.

40. Accipiter velox. Sharp-shinned Hawk. Common, breeds.

41. Accipiter cooperii. Cooper's Hawk. Not numerous, breeds.

42. Buteo borealis calurus. Western Red-tail. Not uncommon, breeds.

43. Archibuteo lagopus sancti-johannis. American Rough-legged Hawk. Seen frequently in flight high overhead.

44. Aquila chrysaetos. Golden Eagle. Common.

45. Haliaeetus leucocephalus. Bald Eagle. Several pairs living in this region.

46. Falco columbarius. Pigeon Hawk. A fine specimen taken July 19, 1902.

47. Falco richardsonii. Richardson's Merlin. A young of the year taken at Swan lake, July 26, 1902.

48. Falco sparverius deserticolus. Desert Sparrow Hawk. Abundant.

49. Pandion haliaetus carolinensis. American Osprey. Common, breeds.

50. Asio wilsonianus. Long-eared Owl. One specimen seen at Selish.

51. Megascops asio maxwelliae. Rocky Mountain Screech Owl. A *specimen taken at Post creek, on the* reservation.

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51. Megascops asio maxwelliae. Rocky Mountain Screech Owl. A *specimen taken at Post creek,* on the reservation.

52. Bubo virginianus subarcticus. Western Horned Owl. Common in the wooded districts.

53. Glaucidium gnoma. Pygmy Owl. Several specimens taken in 1902.

54. Ceryle alcyon. Belted Kingfisher. Abundant.

55. Drybates villosus hyloscopus. Cabanis's Woodpecker. Common.

56. Dryobates pubescens oreoecus. Batchelder's Woodpecker. Common.

57. Picoides arcticus. Arctic Three-toed Woodpecker. Not uncommon.

58. Picoides americanus dorsalis. Alpine Three-toed Woodpecker. Not uncommon.

59. Sphyrapcus varius nuchalis. Red-naped Sapsucker. Common, breeds.

60. Ceophloeus pileatus. Pileated Woodpecker. Common in the heavy woodlands.

61. Melanerpes torquatus. Lewis's Woodpecker. Common.

62. Colaptes cafer. Red-shafted Flicker. Abundant.

63. Chordeiles virginianus henryi. Western Nighthawk. Abundant.

64. Selasphorus rufus. Rufous Hummingbird. Common, breeds.

65. Stellula calliope. Calliope Hummingbird. Not uncommon.

66. Tyrannus tyrannus. Kingbird. Abundant, breeds.

67. Tyrannus verticalis. Arkansas Kingbird. Common, locally, breeds.

68. Contopus borealis. Olive-sided flycatcher. Not uncommon on the mountain slopes.

69. Contopus richardsonii. Western Wood Pewee. Common.

70. Empidonax traillii. Traill's Flycatcher. Common.

71. Empidonax wrightii. Wright's Flycatcher. Common.

72. Otocoris alpestris arenicola. Desert Horned Lark. Abundant on the prairies.

73. Pica pica hudsonica. American Magpie. Very common, breeds.

74. Cyanocitta stelleri annectens. Black-headed Jay. Common, breeds.

75. Perisoreus canadensis capitalis. Rocky Mountain Jay. Common.

76. Corvus corax sinuatus. American Raven. Not uncommon.

77. Corvus americanus. American Crow. Generally distributed.

78. Nucifraga columbiana. Clarke's Nutcracker. Common in the mountains.

79. Dolichonyx oryzivorus. Bobolink. Common in the fall on the reservation.

80. Molothrus ater. Cowbird. Not common.

81. Xanthocephalus xanthocephalus. Yellow-headed Blackbird. Seen only at Swan lake.

82. Agelaius phoeniceus. Red-winged Blackbird. Not very common.

83. Sturhella magna neglecta. Western Meadowlark. Abundant.

84. Spinus pinus. Pine Siskin. Abundant, breeds.

85. Scolecophagus cyanocephalus. Brewer's Blackbird. Abundant, breeds.

86. Coccothraustes vespertinus montanus. Western Evening Grosbeak. Very common in 1901 in the vicinity of the Station.

87. Carpodacus cassini. Cassin's Purple Finch. Common at the head of Swan lake.

88 Loxia curvirostra minor. American Crossbill. Generally common in late summer.

89. Spinus pinus. Pne Sisikin. Abundant, breeds.

90. Pooecetes gramineus confinish. Western Vesper Sparrow. Abundant, breeds.

91. Ammodramus savannarum perpallidus. Western Grasshopper Sparrow. Common.

92. Spizella socialis arizonae. Western Chipping Sparrow. Abundant, breeds.

93. Junco hyemalis shufeldti. Shufeldt's Junco. Common, breeds.

94. Melospiza melodia montana. Mountain Song Sparorw. Common, breeds.

95. Melospiza lincolnii. Lincoln's Sparrow. Not common.

96. Melospiza georgiana. Swamp Sparrow. One specimen taken Aug. 11, 1900, from a group of three or four.

97. Passerella iliaca schistacea. Slate-colored Sparrow. Found breeding in the woods at the base of McDougal Peak.

98. Pipilo maculatus arcticus. Arctic Towhee. Common, breeds.

99. Habia melanocephala. Black-headed Grosbeak. Common, breeds.

100. Cyanospiza amoena. Lazuli Bunting. Common, breeds.

101. Pirang ludoviciana. Louisiana Tanager. Abundant, breeds.

102. Petrochelidon lunifrons. Cliff Swallow. Common.

103. Hirunda erythrogastea. Barn Swallow. Common, breeds.

104. Tachycineta bicolor. Tree Swallow. Common, breeds.

105. Clivicola riparia. Bank Swallow. Common, breeds.

106. Ampelis cedrorum. Cedar Waxwing. Abundant, breeds.

107. Vireo olivaceus. Red-eyed Vireo. Common, breeds.

108. Vireo gilvus. Warbling Vireo. Common, breeds.

109. Dendroica aestiva. Yellow Warbler. Abundant, breeds.

110. Dendroica auduboni. Audubon's Warbler. Common, breeds.

111.Dendroica townsendi. Townsend's Warbler. Abundant, breeds.

112. Geothlypis macgillivrayis. Macgillivray's Warbler. Common, breeds.

113. Geothlypis trichas occidentalis. Western Yellow-throat. Common, breeds.

114. Icteria virens longicauda. Long-tailed Chat. Abundant at Selish, on reservation, and at Bigfork.

115. Sylvania pusilla. Wilson's Warbler. Found nesting at McDonald lake, June 24, 1901.

116. Setophaga ruticilla. American Redstart. Abundant, breeds.

117. Cinclus mexicanus. American Dipper. Common, breeds.

118. Galeo*scoptes carolinensis. Catbird.* Common, breeds.

119. Salpinctes absoletus. Rock Wren. Common.

120. Troglodytes aedon aztecus. Western House Wren. Common, breeds.

121. Troglodytes hiemalis pacificus. Western Winter Wren. Common.

122. Cistothorus palustris plesius. Western Marsh Wren. Noted only at the head of Swan lake, 1902.

123. Certhia familiaris montanus. Rocky Mountain Creeper. Common.

124. Sitta carolinensis aculeata. Slender-billed Nuthatch. Common.

125. Sitta canadensis. Red-breasted Nuthatch. Common.

126. Parus atricapillus septentrionalis. Long-tailed Chickadee. Common, breeds.

127. Parus gambeli. Mountain Chickadee. One specimen noted on McDougal Peak. Breeds at Bigfork.

128. Regulus satrapa. Golden-crowned Kinglet. Common.

129. Regulus calendula. Ruby-crowned Kinglet. Common, breeds.

130. Myadestes townsendii. Townsend's Solitaire. Common, breeds.

131. Hylocichla fuscescens salicicola. Willow Thrush. Not uncommon, breeds.

132. Hylocichla ustulatus swainsonii. Olive-backed Thrush. Abundant, breeds.

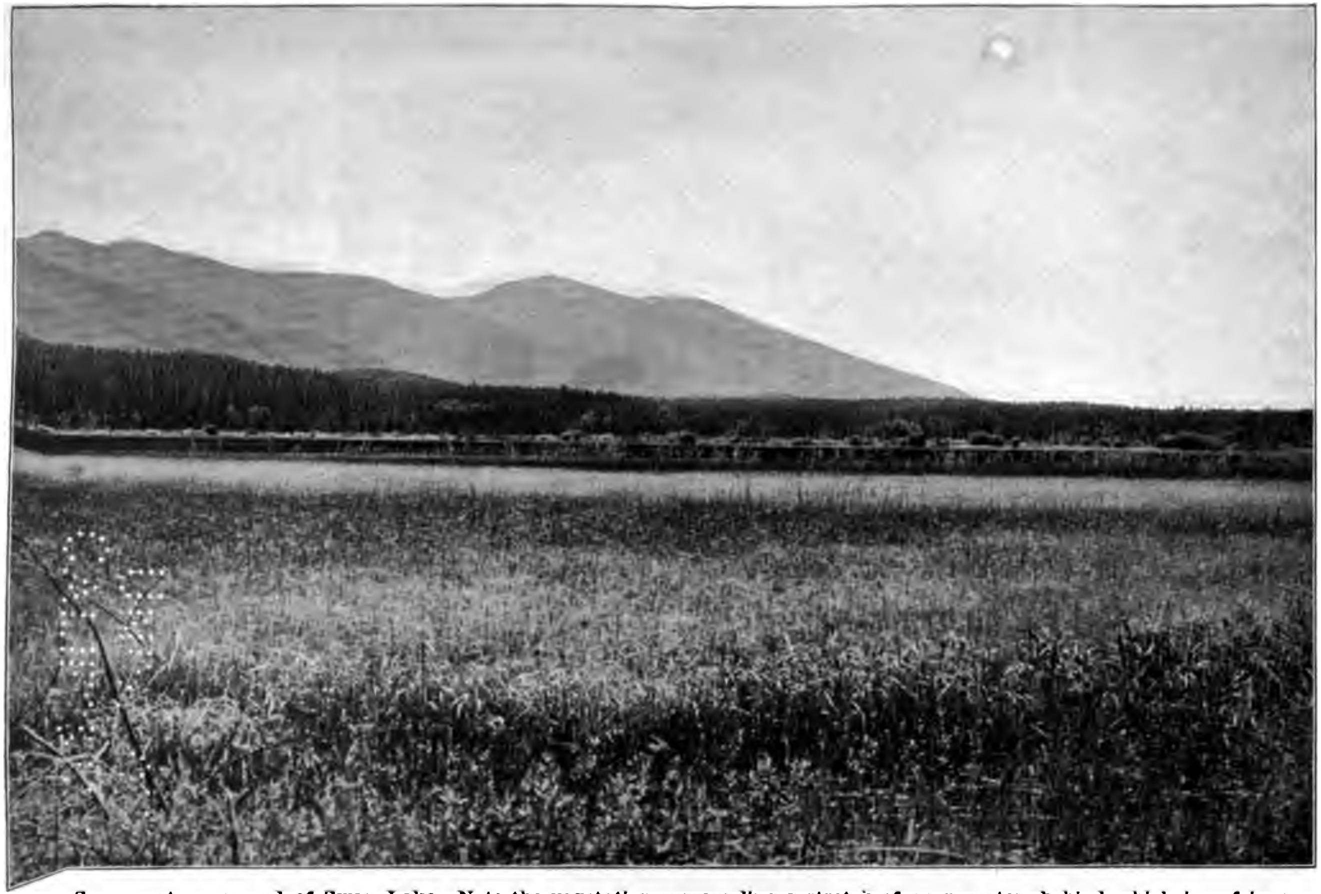
133. Merula migratoria propinqua. Western Robin. Abundant, breeds.

134. Ixoreus naevius. Varied Thrush. Common at the head of Swan lake, breeds.

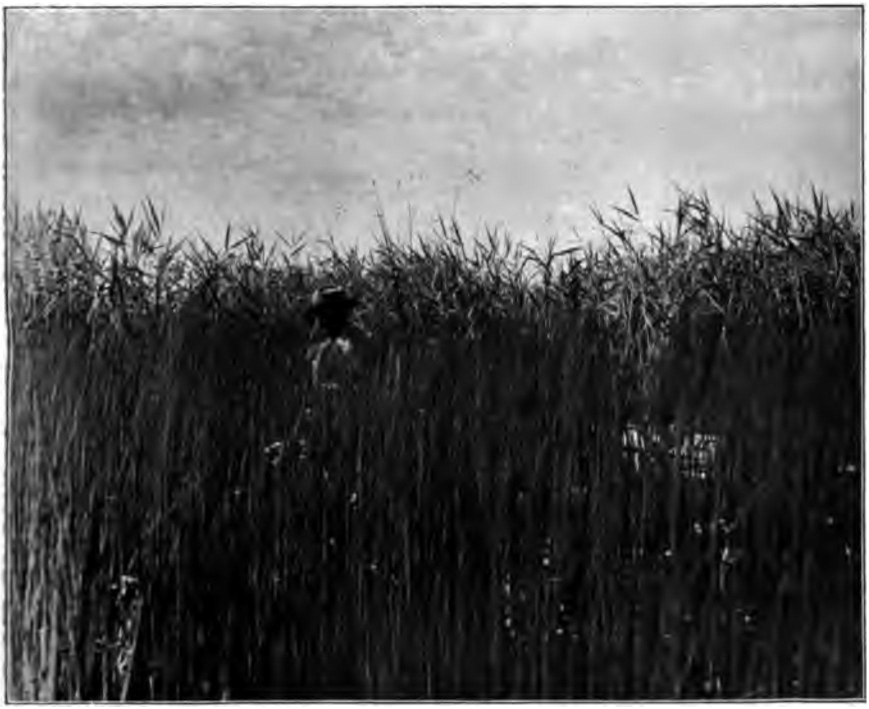
135. Sialia arctica. Mountain Bluebird. Common.

136. Recurvirostra americana. American Avocet. Only one specimen observed, Flathead river, 1903.

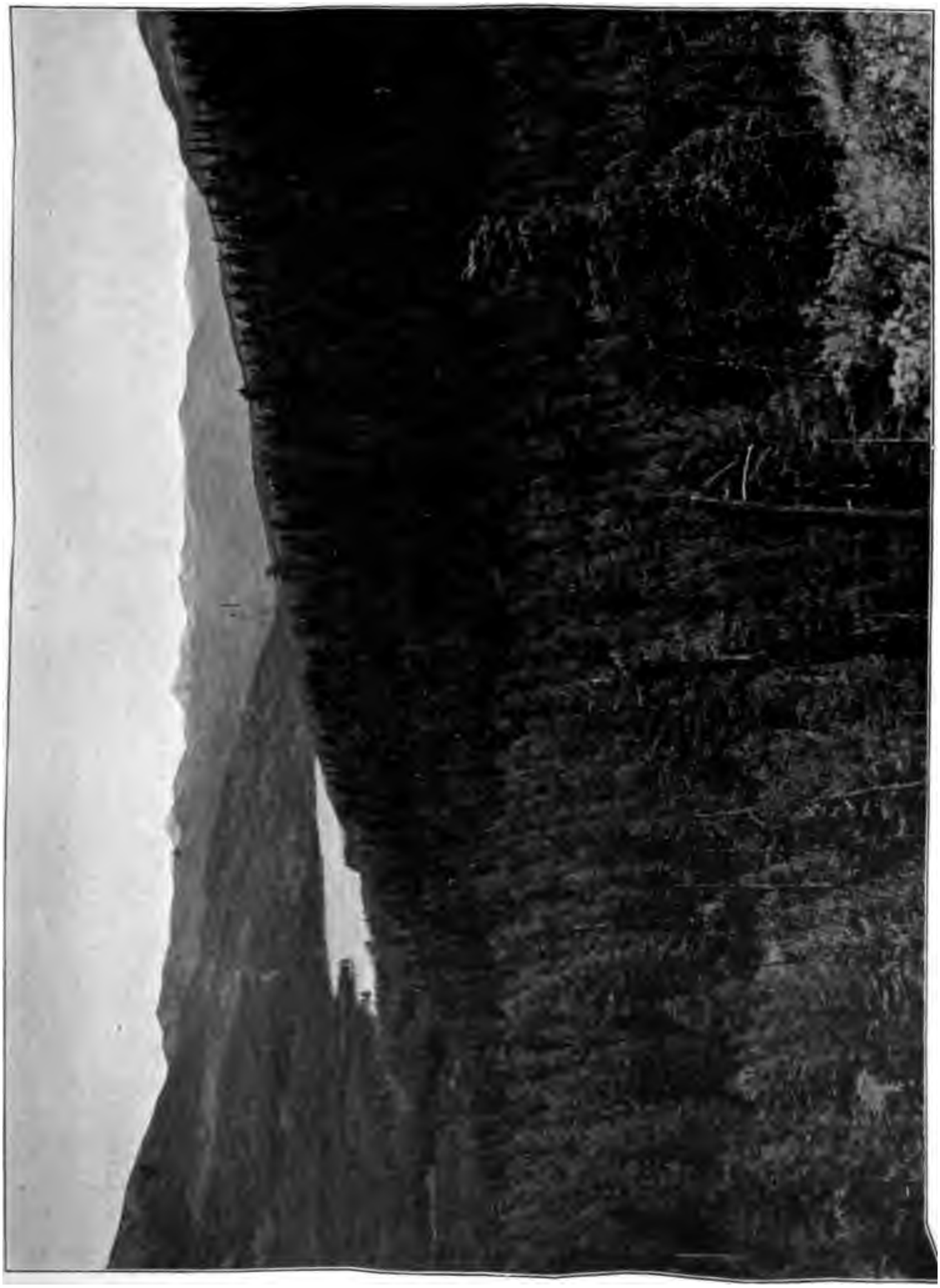
137. Seiurus noveboracensis notabilis. Grinnell's Water-Thrush. Common, in swampy woods. Breeds.



Swamp at upper end of Swan Lake. Note the vegetation surrounding a stretch of open water, behind which is a fringe of willows, alders and swamp birches. Compare with Plate LIII. Southern end of Swan Range in the background. Photo in ly 1902 by M. J. Elrod. The view is S. E.



Showing height and density of the vegetation in the swamp at the upper end of Swan Lake. Photo by Maurice Ricker.



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Bulletins of the University of Montana, Biological Series.

No. 1. Summer Birds of Flathead Lake, by P. M. Silloway. 84 pp., Plates I—XVI.

No. 2. Announcement of the Fourth Annual Session of the University of Montana Biological Station. 4 pp.

No. 3. A Biological Reconnoissance in the Vicinity of Flathead Lake, by Morton J. Elrod. Pp. 89—18-21, plates XVIII—XLVI, figs. 1—3.

No. 4. Anouncement of the Fifth Annual Session of the University of Montana Biological Station. Pp. 183—190, 4 ills.

No. 5. Lectures Delivered at the University of Montana Biological Station during the Session of 1902. Pp. 191—288, plates XLVII—LII, figs. 4—31.

No. 6. Additional Notes to Summer Birds of Flathead Lake, by Perley Milton Silloway, with Introduction by Morton J. Elrod. Pp. 289—308, plates LIII—LVII.

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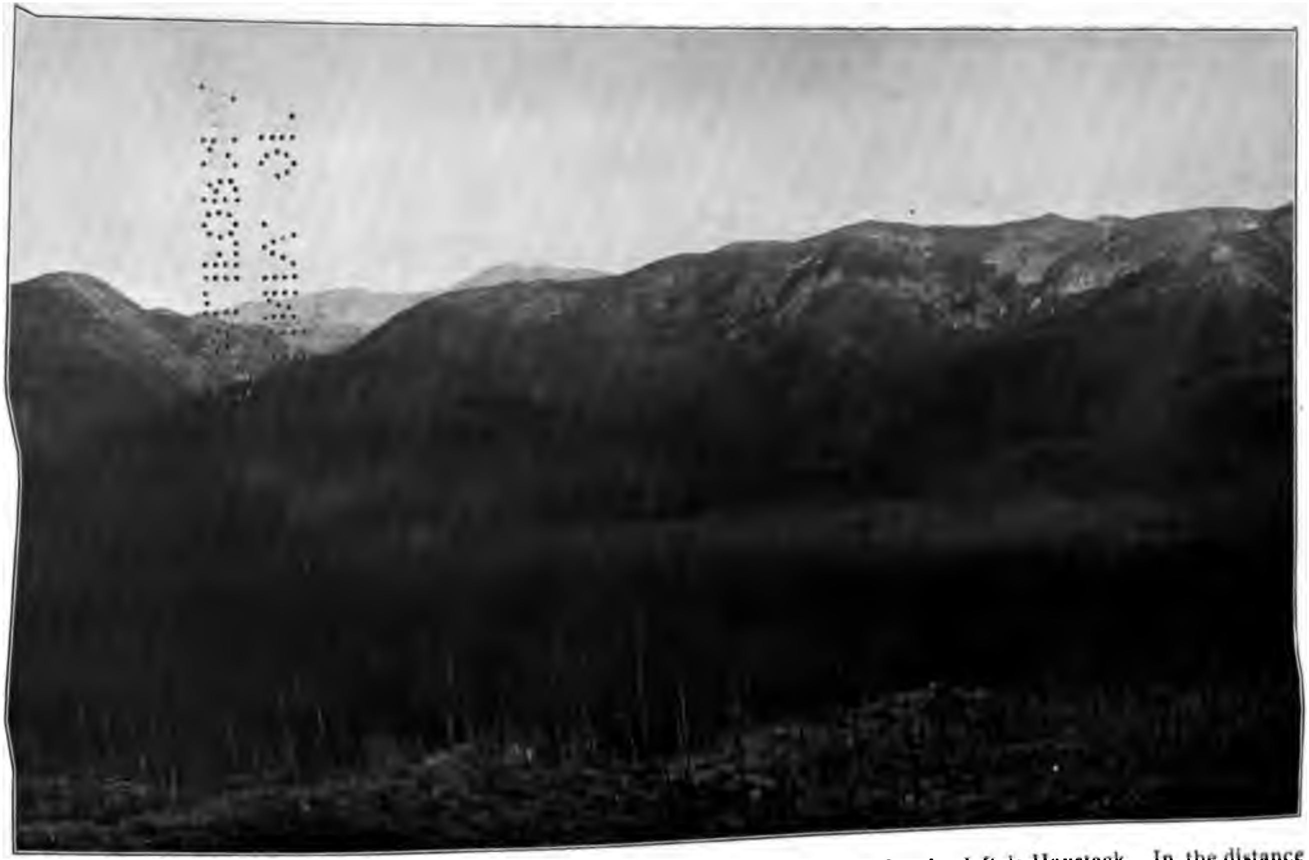

View of portion of the Swan River Valley, the Swan Range in the Background. On the left is Haystack. In the distance is Gilloway Mountain. The big mountain in the foreground is Craig, only a portion of which is shown. This is typical of the country in which the collections were made. The whole region is wooded. Photo in July, 1902, by M. J. Elrod. The view is east.

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Introduction.

The material represented in this bulletin was collected by Wilson P. Harris, as will be noted later. The identifications were made by his mother, Mrs. Isaac Harris. As a basis for subsequent work I deem it advisable to record the results in permanent form, without attempting descriptions or keys for identification.

The localities marked with an * are from material collected by myself at different times, and identified by Prof. Bruce Fink. The notes enclosed in brackets are my own.

The illustrations were made at the University of Montana, due credit being given therefor. By consulting Bulletins Nos. 3, 4, 5 and 6 of the Biological Series many additional illustrations of the region may be seen, showing the character of the country, soil, mountain summits, etc.

The mosses were identified by Mrs. Elizabeth G. Britton, the well known authority for this group.

Duplicates of the collections made by Mr. Harris are in the possession of Mr. Harris and his mother, of the New York Botanical Garden at Bronx Park, and at the University of Montana at Missoula, Mont.

MORTON J. ELROD.

Missoula, Mont., June 17, 1903.

Preliminary Announcement.

These specimens were collected while I was with an expedition from the University of Montana, with the co-operation of the New York Botanical Garden, to collect biological specimens in the Flathead and Mission valleys in Flathead county, Montana. The time of collecting was about seven weeks, from the middle of June to the middle of August, 1901. The elevations varied between 2,600 and 7,700 feet above sea level.

Some collecting was done on the mountains around Missoula and in the valley of the Missoula river before the expedition set out. The mountains are steep pastured slopes, with occasional outcrops of shale. They are heavily wooded on the summits with **Pinus ponderosa** and **Pseudotsuga taxifolia.** The valley is a flat wooded plain, with a limestone silt soil and some white alkali.

The expedition travelled through the Missoula valley to O'Keefe canyon, then up this canyon to Evaro. The canyon is narrow and steep, with a small stream running through it. It is heavily wooded. The soil is scanty, with a large per cent of lime.

From Evaro the expedition travelled down to the Jocko valley, then to Selish. The valley is wide, covered with native prairie grass. From there the expedition moved to Sinyaleamin lake. This body of water is in a "pocket" in the Mission mountains. The country is heavily wooded with Engelmann's spruce, bull (yellow) pine and cedar. The soil is fine limestone silt over a glacial gravel. During the stay of five days excursions were made up the mountain sides and over the low pass to the south as far as the series of small ponds.

From Sinyaleamin the expedition moved to McDougal lake, which is about twenty miles to the north, in the same range. The timber here is principally bull pine and Douglas spruce, and is confined principally to the bottom of the valley. The mountain sides were very precipitous, covered with limestone shale and brush. Owing to the position of the lake and to the rainy weather, very little collecting was done except along the shores of the lake.

From McDonald lake a move was made to Mud creek, near its source in the mountains, a distance of thirty miles.. The country is flat and heavily timbered with bull pine and larch (tamarack), with some spruce. The soil is deep rich clay loam. There is no appearance of alkali. At this place some specimens of water-loving mosses were found.

From Mud creek the next move was to the lower end of Flathead lake, on the east shore. During the stay of five days in this region collecting was done on the lake shore and well up the mountain sides. The soil

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These specimens were collected while I was with an expedition from the University of Montana, with the co-operation of the New York Botanical Garden, to collect biological specimens in the Flathead and Mission valleys in Flathead county, Montana. The time of collecting was about seven weeks, from the middle of June to the middle of August, 1901. The elevations varied between 2,600 and 7,700 feet above sea level.

Some collecting was done on the mountains around Missoula and in the valley of the Missoula river before the expedition set out. The mountains are steep pastured slopes, with occasional outcrops of shale. They are heavily wooded on the summits with **Pinus ponderosa** and **Pseudotsuga taxifolia.** The valley is a flat wooded plain, with a limestone silt soil and some white alkali.

The expedition travelled through the Missoula valley to O'Keefe canyon, then up this canyon to Evaro. The canyon is narrow and steep, with a small stream running through it. It is heavily wooded. The soil is scanty, with a large per cent of lime.

From Evaro the expedition travelled down to the Jocko valley, then to Selish. The valley is wide, covered with native prairie grass. From there the expedition moved to Sinyaleamin lake. This body of water is in a "pocket" in the Mission mountains. The country is heavily wooded with Engelmann's spruce, bull (yellow) pine and cedar. The soil is fine limestone silt over a glacial gravel. During the stay of five days excursions were made up the mountain sides and over the low pass to the south as far as the series of small ponds.

From Sinyaleamin the expedition moved to McDougal lake, which is about twenty miles to the north, in the same range. The timber here is principally bull pine and Douglas spruce, and is confined principally to the bottom of the valley. The mountain sides were very precipitous, covered with limestone shale and brush. Owing to the position of the lake and to the rainy weather, very little collecting was done except along the shores of the lake.

From McDonald lake a move was made to Mud creek, ne[illegible] its source in the mountains, a distance of [illegible] coun[illegible]at and heavily timbered with bull pin[illegible] wh[illegible]pruce. The soil is deep rich clay lo[illegible]an[illegible]l. At this place some specimens [illegible]

From Mud creek the [illegible]eu[illegible]d lake,

ing

soil

and vegetation was of the same general character as that of McDonald lake.

From this place the expedition moved directly to the University of Montana Summer Station at Bigfork. From this as a base excursions were made into the Swan range. The first was to Echo lake. On this trip MacDougal peak was ascended. Camp was later moved to Rost lake. From there a trip was made to Wolf creek canyon, to Silloway mountain, then around Wolf creek head, over Craig mountain, and return to camp. Wolf creek valley is heavily timbered with bull pine, larch and Douglas spruce. On the mountain side the Douglas spruce predominates, but near the summit of the range gives way to a small scrubby pine. The soil is scanty on the hills and is covered by a species of yucca known locally as bear grass.

On this trip the Usnea was noticed at the elevation of 5,800 feet on the south-western slopes, and not above 5,000 feet on eastern and northern slopes.

The second trip from Bigfork was to Swan lake. No collecting was done except along shore.

The distances between the various stations have never been measured and are rather uncertain. The elevations were determined by Prof. M J. Elrod, of the University of Montana.

W. P. HARRIS.

125 St. Marks Ave., Brooklyn, February 9, 1902.

List of Species of Lichens.

Acolium tympanellum (Ach.) De Not.
Bigfork, Flathead Lake, 2,960 ft., July 6, 1901.
Rost Lake, Alt. 3,000 ft., July 13, 1901.
Echo Lake,* Alt. 5,000 ft., August 12, 1901.

Alectoria jubata (L.), var. **chalybeiformis** Ach.
O'Keefe canyon, 4,000 ft., June 14, 1901.

Alectoria ochroleuca (Ehrh.) Nyl., var. **rigida** Fr.
O'Keefe canyon, Alt. 3,500 ft., June 14, 1901.

Alectoria ochroleuca (Ehrh.) Nyl. var. **sarmentosa** Nyl.
Rost Lake, Alt. 3,000 ft., July 20, 1901.
Craig Mountain, 6,150 ft., July 19, 1901.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.

Alectoria fremontii Tuckm.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.
*Missoula, Alt. 3,225 ft.

(This is commonly spoken of as "black moss." It seems to grow most luxuriantly on Douglas Spruce, Pseudotsuga mucronata (Raf.) Seed. It often trails from the limbs a foot or more. Sometimes it almost covers a small tree from top to base. Indeed, it is possible the lichen kills small trees by covering the leaves and shutting out the sun. In dense woods and damp places it grows in great abundance.)

Baeomyces aeruginosus (Scop.) DC.
Wolf Creek, Alt. 3,600 ft., July 31, 1901.
Craig Mountain, 6,700 ft., July 19, 1901.

Biatora paddensis Tuck.
O'Keefe Canyon, 4,000 ft., June 14, 1901.
Rost Lake, 3,000 ft., July 15, 1901.

Biatora decipiens (Ehrh.) Fr.
Mission range, 3,000 ft., June 29, 1901.

Biatora rufonigra Tuckm.
Silloway Mountain, 7,650 ft., June 18, 1901.

Buellia petraea (Flot. Koerb.) Tuckm. var. **montagnoei** Tuck.
* On rocks. Missoula, Alt. 3,225, Oct. 20, 1896.

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* *This locality* must be on the mountain side above Echo Lake. If *not the altitude is incorrect*, as this is almost on the same level as Rost *Lake.*

Buellia geographica (L.) Tuckm.
McDonald Lake, 3,800 ft., June 23, 1901.

Buellia oidalea Tuckm.
Rost Lake, 3,000 ft., July 15, 1901.

Calicium quercinum Pers.
Echo Lake, Alt. 3,000 ft., August 12, 1901.

Cetraria platyphylla Tuckm.
O'Keefe canyon, 4,000 ft., June 14, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June, 1897.
Sinyaleamin lake, 3,800 ft., June 29, 1901.

Cetraria ciliaris (Ach.) Tuck.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.

Cetraria glanca (L.) Ach.
O'Keefe Canyon, 4,000 ft., June 14, 1901.
McDonald Lake, 3,800 ft., June 22, 1901.
Mud Creek, 2,700 ft., June 28, 1901.
Swan Lake, 3,200 ft., Aug. 16, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.

Cetraria juniperina (L.) Ach.
Sinyaleamin Lake, 3,800 ft., June 21, 1901.
Swan Lake, 3,200 ft., Aug. 16, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 27, 1897.

Cladonia amaurocraea (Fl.) Schaer.
McDonald Lake, Alt. 3,800 ft., June 24, 1901.

Cladonia caespiticia (Pers.) Fl.
Silloway Mountain, Alt. 7,750, July 18, 1901.

Cladonia cariosa (Ach.) Spreng.
McDonald Lake, Alt. 3,800 ft., June 23, 1901.

Cladonia crispata (Ach.) Flot., var. **infundibulifera** (Schaer.) Wa
McDonald Lake, Alt. 3,800 ft., June 24, 1901.

Cladonia coccifera (L.) Willd., var. **pleurota** (Flk.) Willd. Craig Mountain.

Cladonia cornuta (L.) Fr.
McDonald Lake, Alt. 3,800 ft., June 25, 1901.

Cladonia deformis (L.) Hoffm.
Sinyaleamin Lake, Alt. 3,800 ft., June 21, 1901.

Cladonia digitata (L.) Hoffm.
Flathead Lake, Alt. 2,900, July 8, 1901.

Cladonia fimbriata (L.) Fr.
* Flathead Lake, Aug., 1899.
* *Lo Lo Hot* Springs, Alt. 5,000 ft., June 25, 1897.
On rotten wood. Abundant on decaying logs.

Lecanora rubina (Vill.) Ach.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
* Missoula, Oct. 20, 1899.

Lecanora subfusca (L.) Ach.
Flathead Lake, Alt. 3,000 ft., July 20, 1901.
Post Creek, 2,800 ft., June 22, 1901.

Leptogium Sp.
Undetermined because of lack of fruiting plants.
* Missoula, Alt. 3,225, 1897.

Lecanora xanthophana Nyl. var. **dealbata** Tuck.
Craig Mountain, Alt. 7,250 ft., July 19, 1901.

Parmelia conspersa (Ehrh.) Ach.
Post Creek, Alt. 2,800 ft., June 22, 1901.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.
* Missoula, Alt. 3,225, 1899.

Parmelia olivacea (L.) Ach.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
St. Ignatius, Alt. 2,800 ft., June 17, 1901.
Post Creek, Alt. 2,800 ft., June 22, 1901.

Parmelia physodes (L.) Ach.
* Lo Lo Hot Springs, Alt. 5,000, June 25, 1897.

Parmelia physodes (L.) Ach., var. **vittata** Ach.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
Sinyaleamin Lake, Alt. 4,000 ft., June 18, 1901.
* Lo Lo Hot Springs, June 25, 1897.

Parmelia physodes (L.) Ach var. **enteromorpha** Tuck.
* Lo Lo Hot Springs, Alt. 5,000, June 25, 1897.

Permelia saxatilis (L.) Fr.
Sinyaleamin Lake, Alt. 3,800 ft., June 19, 1901.
* Flathead Lake, Alt. 3,000 ft., Aug. 1, 1899.

Parmelia saxatilis (L.) Fr., var. **sulcata** Nyl.
O'Keefe Canyon, Alt. 4,000 ft., June 14, 1901.
McDonald Lake, Alt. 3,300 tf., June 25, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897

Peltigera apthosa (L.) Hoffm.
Sinyaleamin Lake, Alt. 3,800 ft., June 20, 1901.
* Missoula, Alt. 3,225, June 6, 1897.
* Lo Lo Hot Springs, Alt. 5,000, June 25, 1897.
* Flathead Lake, Alt. 3,000, Aug., 1899.

Peltigera canina (L.) Hoffm.
Sinyaleamin Lake, Alt. 3,800 ft., June 20, 1901.
O'Keefe Canyon, Alt. 3,000 ft., June 14, 1901.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.
* Flathead Lake, Alt. 3,000 ft., Aug., 1899.
* Missoula, Alt. 3,225, June 8, 1897.

Peltigera venosa (L.) Hoffm.
Bigfork, Alt. 3,000 ft., July 8, 1901.

Placodium Elegans (Link.) D. C.
McDonald Lake, Alt. 3,300 ft., June 24, 1901.
* Missoula, Alt. 3,225, Aug., 1898.

Physcia stellaris (L.) Tuckm.
St. Ignatius, Alt. 2,800 ft., June 17, 1901.

Physcia stellaris (L.) Tuckm., var. **alpolia** Nyl.
Flathead Lake, Alt. 3,000 ft., July 6, 1901.

Rinodeina oreina (Ach.) Mass.
* Missoula, Alt. 3,225, Oct. 20, 1899.
On rocks.

Ramalina calicaris (L.) Fr., var. **fastigiata** Fr.
Flathead Lake, Alt. 3,000 ft., Aug. 14, 1901.

Sticta pulmonaria (L.) Ach.
Mud Creek, Alt. 2,700 ft., June 28, 1901.
McDonald Lake, Alt. 3,300 ft., June 24, 1901.

Theloschistes Lychnens (Nyl.) T.
Bigfork, Alt. 3,000, July 6, 1901.
* Missoula, Alt. 3,225 ft., Oct. 11, 1898.

Umbilicaria hyperborea Hoffm.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.

Umbilicaria phaea Tuckm.
McDonald Lake, Alt. 3,300 ft., June 23, 1901.

Umbilicaria vellea (L.) Nyl.
McDonald Lake, Alt. 3,300 ft., June 13, 1901.
* Lo Lo Hot Springs, Alt. 5,000 ft., June 25, 1897.

(This is a beautiful species, jet black beneath, greenish brown or brown above. It covers the wet surfaces of rocks with its broad, thick thallus, often to the extent of several square yards.)

Usnea barbata (L.) Fr.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.
Mud Creek, Alt. 2,700 ft., June 28, 1901.
* Flathead Lake, Alt. 3,000 ft., August, 1899.

Usnea barbata (L.) Fr., var. **hirta** Fr.
Sentinel Mountain, Alt. 5,000 ft., June 12, 1901.

Usnea cavernosa Tuckm.
McDonald Lake, Alt. 3,300 ft., June 26, 1901.

List of Mosses.

Atrichum selwyni Anst.
O'Keefe Canyon, 3,000 feet, on clay, June 14, 1901.

Aulacomnium androgyniom Schwaegr.
McDonald Lake, Mission Mountains, 3,300 feet, June 23, 1901.

Amblysteglum varium (Hedw.) Lindt.
Mud Creek 2,700 ft., on earth, June 28, 1901.

Campothecium aeneum Mitt.
Old Stage Station, east side Flathead Lake, 2,600 feet, on dead **Pinus ponderosa**, June 28, 1901.

Bryum bimum Schreb., same as
Ceratodon purpureus Brid.
Mud Creek, 2,700 feet, June 28, 1901.

Climacium dendroides Met. and Wohr.
McDonald Lake, 3,300 ft., on earth in swamp, June 24, 1901.

Dicranum bergeri Bland.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901.

Dicranum fragilifolium Lindt.
Mud Creek, 2,700 feet, June 28, 1901.
McDonald Lake, Mission Mountains, June 24, 1901.

Dicranum strictum Schleich.
O'Keefe Canyon, 3,000 feet, on dead wood, June 14, 1901.

Eucalypta macounii Aust.
McDonald Lake, Mission Mountains, 3,300 feet, on earth, June 25, 1901.

Euhrynchium strigosum B. & S.
McDonald Lake, Mission Mountains, 3,800 feet, June 23, 1901.

Fontinalis antipyretica L.
Mud Creek, 2,700 feet, in water, June 28, 1901.

Grimmia calyptrata Hook.
Missoula, 3,200 feet, wet rocks, June 13, 1901.

Grimmia montana B. and S.
Bigfork, 2,900 ft., on dry rocks, June 26, 1901.

***Hylocomium* triquetrum** (L.) B. & S.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901, *in cedar* swamp.

Hylocomium proliferum (L.) Lindb.
McDonald Lake, Mission Mountains, 3,300 feet, in cedar swamp, June 25, 1901.

Hypnum cuspidatum L.
Mud Creek, 2,700 feet, on dead wood, June 28, 1901.

Hypnum fluitans L.
Daphni Pond, 2,700 feet, in swamp, July 5, 1901.

Hypnum giganteum Schimp.
Mud Creek, 2,700 feet, June 28, 1901.

Hypnum subimponens Lesq.
McDonald Lake, Mission Mountains, 3,300 feet, on damp rocks, June 24, 1901. Also found on earth.

Hypnum uncinatum Hedw.
McDonald Lake, 3,300 ft., on wood, June 25, 1901.

Leptobrium pyriforme Schimp.
O'Keefe Canyon, 3,000 feet, on clay, June 14, 1901.

Mnium affine Bland.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901.

Mnium insigne Mitt.
McDonald Lake, Mission Mountains, in cedar swamp, 3,300 feet June 24, 1901.

Mnium medium B. & S.
McDonald Lake, Mission Mountains, in cedar swamp, 3,300 feet, June 24, 1901.

Mnium orthorrynchum B. and S.
McDonald Lake, 3,300 feet, in cedar swamp, June 25, 1901.

Mnium punctatum Hedw.
McDonald Lake, 3,300 ft., on damp earth, June 25, 1901.

Mnium spinulosum B. and S.
McDonald Lake, Mission Mountains, 3,300 feet, on earth, June 24, 1901.

Mnium venustum Mitt.
McDonald Lake, Mission Mountains, 3,300 feet, June 25, 1901.

Neckera douglasii Hook.
McDonald Lake, Mission Mountains, 3,300 feet, on wet rocks, June 25, 1901.

Orthotrichum speciosum Nels. same as
Grimmia orata Met. and Wohr.
McDonald Lake, 3,300 ft., in cedar swamp, June 24, 1901.

Orthotrichum rupestre Schleich.
McDonald Lake, 3,300 ft., on earth with lichens, June 24, 1901.

Plagiothecium elegans Schimp.
McDonald Lake, Mission Mountains, 3,300 feet, on dead wood, June 14, 1901.

Polytrichum piliferum Schrib.
O'Keefe Canyon, 3,000 feet, on clay, June 14, 1901.

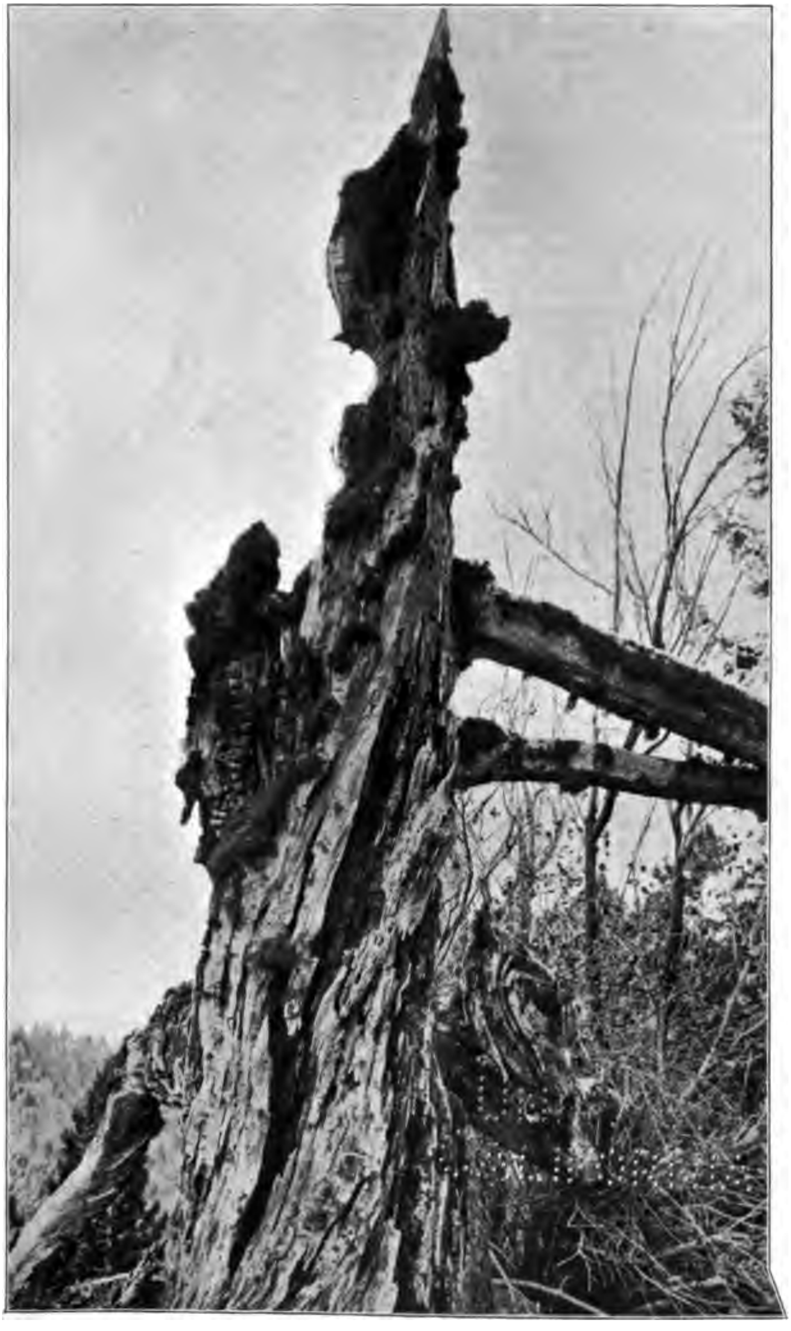
Timmia megapolitana Hedw.
McDonald Lake, 3,300 ft., June 23, 1901.
Mud Creek, 2,700 ft., June 28, 1901.

Tortula ruralis Ehrh.
O'Keefe Canyon, 3,000 feet, June 14, 1901.
McDonald Lake, Mission Mountains, 3,300 feet, in cedar swamp, June 24, 1901.

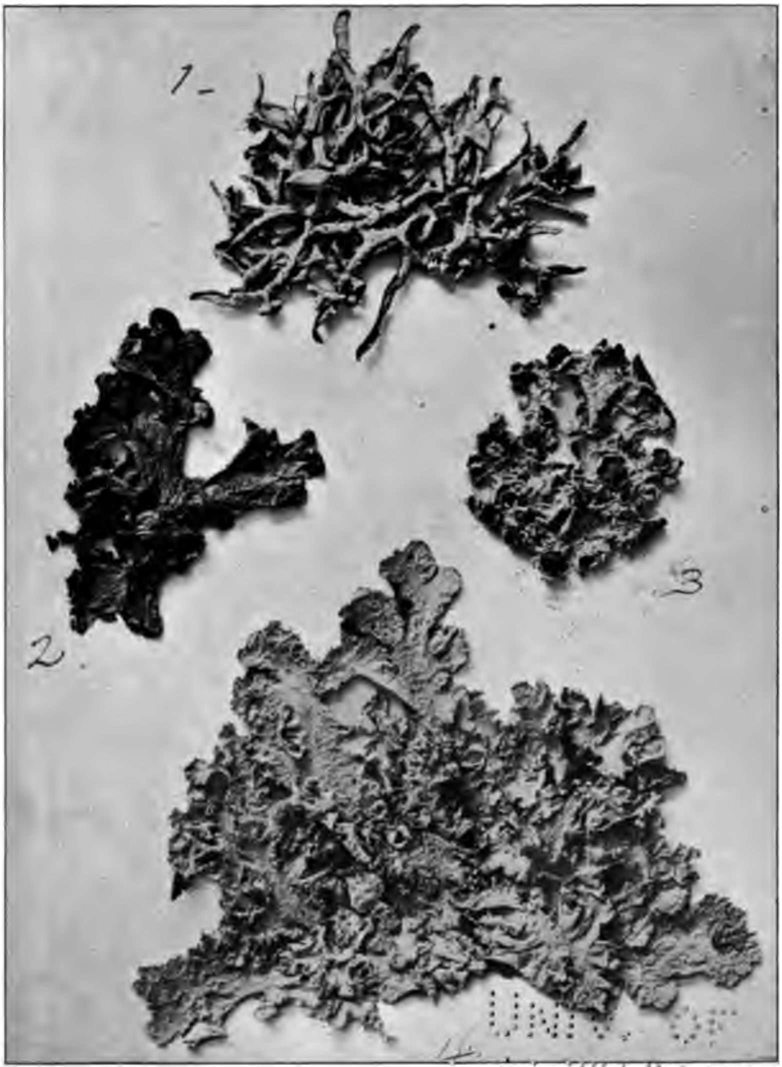
Webera nutans Hedw.
O'Keefe Canyon, 3,000 feet, on dead wood, June 14, 1901.
Sinyaleamin Lake, 3,800 feet, on earth, June 21, 1901.

Summary

Lichens, genera 20, Species 67.
Mosses, genera 19, Species 37.
Total, genera 39, Species 104.

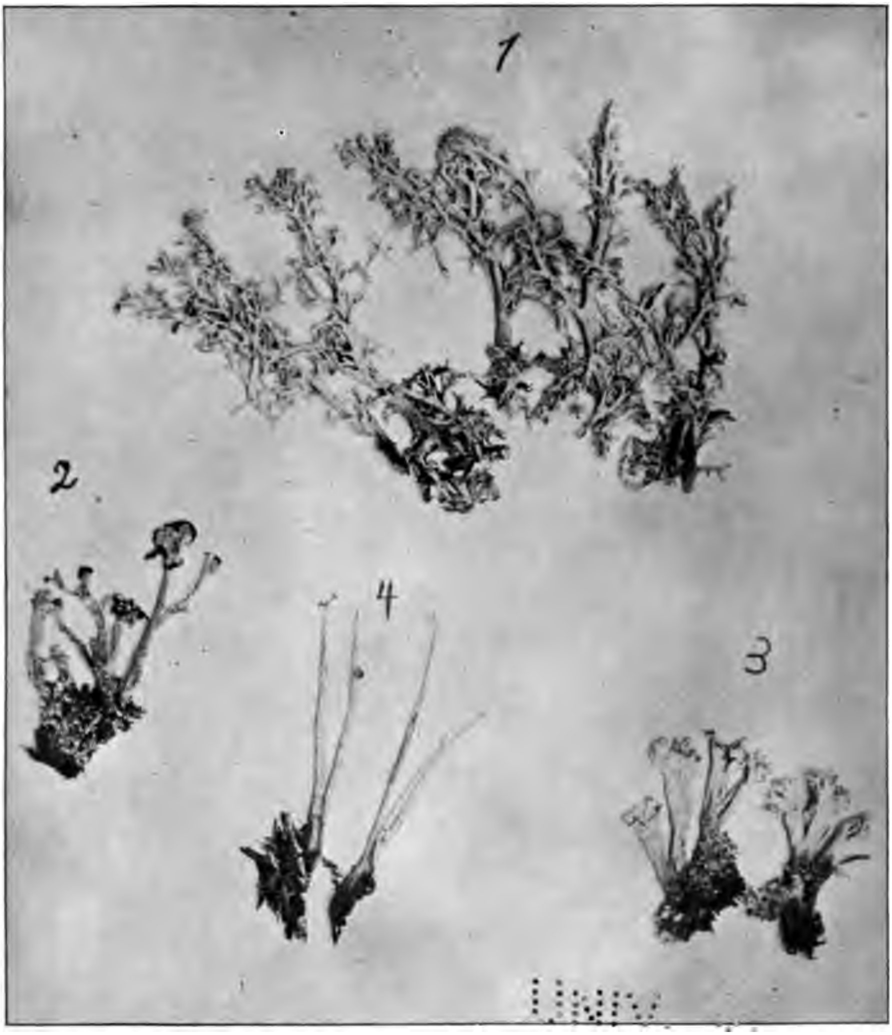


6150.' *Evernia vulpina (L) Ach.*, on old stump. Mitten Mountain, Missoula, [illegible].



UNIV. OF CALIFORNIA

1. Parmelia physodes var vittata.
2. Cetraria platyphylla.
3. Cetraria juniperina.
4. Cetraria glanca.



1. Cladonia rangiferina var sylvatica.
2. Cladonia cariosa.
3. Cladonia deformis.
4. Cladonia cornuta.

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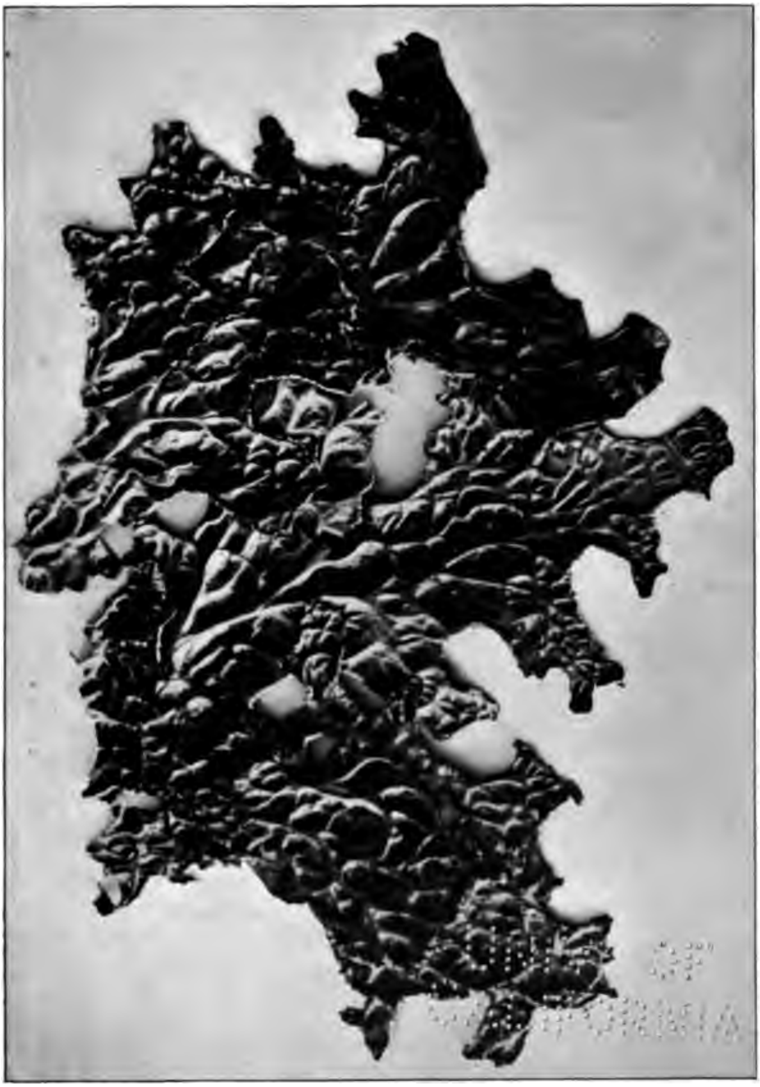
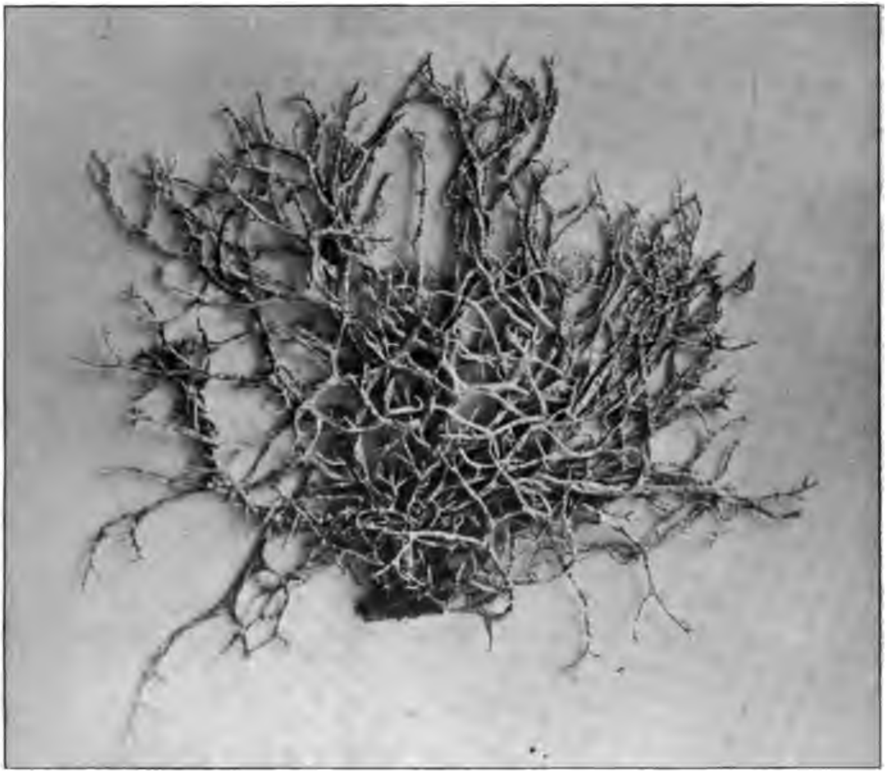
Plate LXII.



Sticta pulmonaria (L.) Ach.



Evernia vulpina (L) Ach., one of the most common lichens in the northwest.

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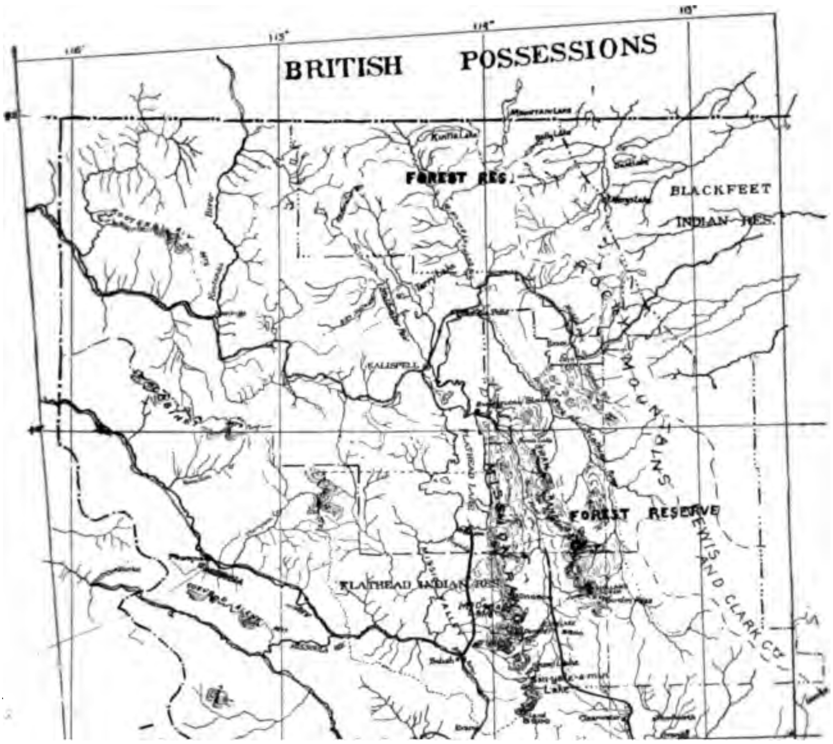
116°
115°
114°
113°
BRITISH POSSESSIONS
Mountain Lake
Kintla Lake
FOREST RES.
Mary Lake
BLACKFEET
INDIAN RES.
KALISPELL
Flathead Lake
ROCKY MOUNTAINS
FOREST RESERVE
LEWIS AND CLARK CO.
FLATHEAD INDIAN RES.
Lake

Bulletins of the University of Montana, Biological Series.

No. 1. Summer Birds of Flathead Lake, by P. M. Silloway. 84 pp., Plates I—XVI.

No. 2. Announcement of the Fourth Annual Session of the University of Montana Biological Station. 4 pp.

No. 3. A Biological Reconnoissance in the Vicinity of Flathead Lake, by Morton J. Elrod. Pp. 89—18-21, plates XVIII—XLVI, figs. 1—3.

No. 4. Anouncement of the Fifth Annual Session of the University of Montana Biological Station. Pp. 183—190, 4 ills.

No. 5. Lectures Delivered at the University of Montana Biological Station during the Session of 1902. Pp. 191—288, plates XLVII—LII, figs. 4—31.

No. 6. Additional Notes to Summer Birds of Flathead Lake, by Perley Milton Silloway, with Introduction by Morton J. Elrod. Pp. 289—308, plates LIII—LVII.

No. 7. Lichens and Mosses of Montana, a list, by Wilson P. Harris and Carolyn W. Harris. Pp. 309-331. Plates LVIII—LXIV.

BULLETIN, UNIVERSITY OF MONTANA
BIOLOGICAL SERIES No. 15

Number 61

MONTANA BOTANY NOTES

CONTAINING

Description of New Species, List of Plants Not Heretofore Recorded
From the State, and Notes on Disputed Species,
With Five Plates

BY

MARCUS E. JONES, A. M.

Prepared From Material Collected at the
University of Montana Biological Station

UNIVERSITY OF MONTANA
Missoula, Montana, U. S. A.
March, 1910

Entered August 24, 1901, at Missoula, Montana, as second class matter,
under act of Congress, *July 16, 1894*

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MISSOULIAN PUBLISHING COMPANY

TYPOGRAPHICAL
UNION LABEL
MISSOULA

CORRECTIONS.

The author's distance from the printer and the loss of the last corrected proofs in transit prevented the correction of certain serious errors.

The drawings in the body of the work were by Miss Gertrude Norton, those in the appendix were by Miss Carol Evans.

Mrs. Joseph Clemens was with our party in 1908 on all the trips but the one to McDonald peak and the Hot Springs, and she collected nearly every species that the writer also got. Miss Norton was with the party but did not make any extensive collections as she had previously done much botanizing in the region.

The list of new species and combinations on page 7 is very incomplete and the body of the work must be consulted for the new names.

In the key to Tsuga, page 10, the names heterophylla and Mertensiana were transposed by the printer, heterophylla should come first, but the description in the key should stand as given without transposition.

Ranunculus Pygmaeus, page 27, should b R. pygmaeus.

Heucheriod, page 33, should be heucheroid.

Colville, page 34, should be Coville.

Spirea densifolia, page 35, should be Spiraea.

Peptotaenia, page 41, should be Leptotaenia.

Cicuta Douglassii, page 42, should be Douglasii.

Erase Krynitzkia crassi on page 44.

Brichellia, page 48, should be Brickellia.

Thousands, page 61, should be thousandths.

Omit Whitewater on page 67.

Carex ablata should be oblata wherever used, see pp. 68, 69.

Other minor errors occur but are of no special significance.

Montana Botany Notes were issued June 10th, 1910.

CORRECTIONS

The author's distance from the place of publication, [illegible]
proofs in transit prevented the correction of certain [illegible]

The drawings in the body of the work were by [illegible]
shown in the appendix were by [illegible]

Mrs. Joseph Clemens was with me [illegible] and
the one to MacDonald peak and the [illegible]
every species that the writer also got. [illegible]
but did not make any extensive collections of [illegible]
much interesting in the region.

The list of new species and combinations [illegible]
and the body of the work must be consulted [illegible]

In the key to Tsuga, page 16 the names [illegible]
were transposed by the printer, [illegible]
descriptions in the key should stand as they were without [illegible]

Ranunculus Pygmaeus, page 27, should be pygmaeus.
[illegible], page 33, should be [illegible]
Colville, page 34, should be Colville.
Spiraea densiflora, page 38, should be [illegible]
[illegible], page 41, should be [illegible]
Carex Douglasii, page 42, should be Douglasii.
Erase [illegible] on page 51.
[illegible], page 46, should be [illegible]
Thermopsis, page 61, should be [illegible]
Omit Whitewater on page 67.
Carex ablata should be placed where the word [illegible] on pp. 68, 69.
Other minor errors occur but are of no special significance.
Montana Botany Notes were finished June 10th, 1909.

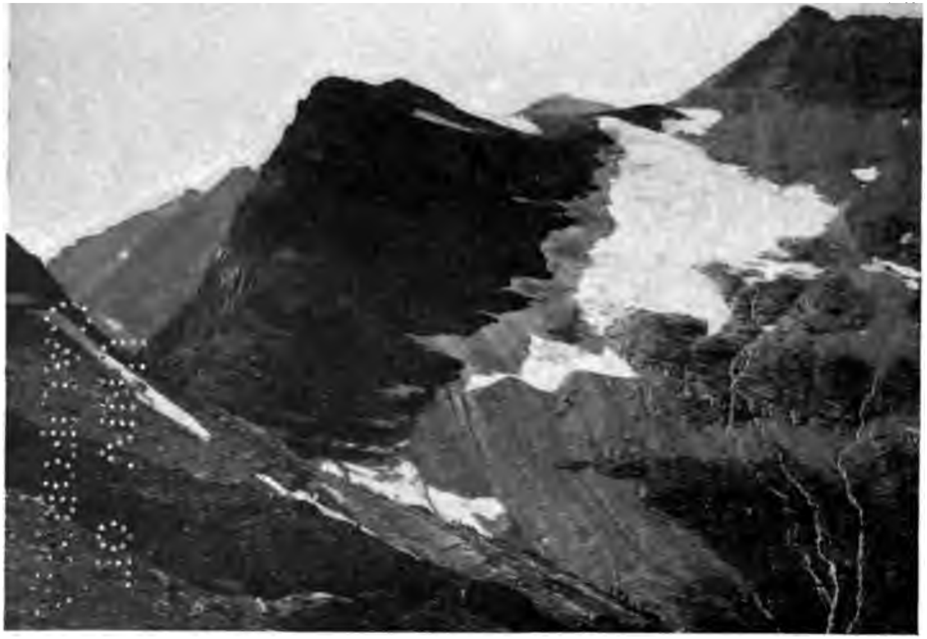


PLATE I.

Cliffs, glacier and waterfalls, looking west at Gunsight Pass, on the Hudson Bay side, continental divide, showing characteristic country in which collections of alpine plants were made.

PREFACE

The object of this paper is simply to publish at this time the main results of the work done by Marcus E. Jones in connection with the Biological Station at Bigfork, so far as important notes, changes of names due to exhaustive field work and new species are concerned. The ecological work and detailed statement of species and localities, zonal distribution, etc., are reserved for a subsequent paper. In addition such additions to the Flathead drainage flora as have been made by Prof. Elrod, Miss Norton and others are here given for the first time, and credited to them. The total flora passed in review covers some 1700 species. The flora of the Flathead Lake region has now been thoroughly worked up except the early spring flora which is meager. It has been the Mecca of botanists for over a decade, but the only publications on its flora have been a paper on the trees, and one on the lichens and mosses and fungi, all of them very incomplete, and sporadic articles on the ferns and horsetails. The collections of Williams, Mrs. Kennedy, MacDougal, Canby, and others from this region have been reported in Rydberg's list of the flora of Montana. This present list does not include any commentary on the identifications of Rydberg except on a few important species of rare occurrence.

Detailed studies of the trees were made and the results are given in this paper.

The fungi on living leaves were carefully studied and collected.

A careful collection of the mosses was also made and nearly a hundred and thirty-five species were added to the known flora.

In 1908 the main work was around Flathead Lake and the adjacent mountains. In 1909 the main work was in the Bitter Root, on McDonald Peak, at Ravalli, the Flathead Plains, Swan River, and the magnificent Sperry Glacier region where the alpine flora reaches its greatest development. Work was also done at Monida and Lima in both years and along the Oregon Short Line, Northern Pacific and Great Northern railways at way stations.

NEW SPECIES DESCRIBED

Glyceria flavescens.

Carex Stantonensis, Stanton Lake Carex.

Sedum Elrodi, Elrod's Stonecrop.

Hypericum Nortonae, Miss Norton's St. John's Wort.

Cogswellia Altensis, Alta Cogswellia.

Cymopterus Elrodi, Elrod's Cymopterus.

Sambucus decipiens, The deceptive Elderberry.

Cylindrosporium simile Peck, Fungus on Ceanothus sanguinea.

Cylindrosporium simile var. pruinum Peck, n. var. Fungus on foliage of Prunus emarginata.

Roestelia tubulata Kern, n. sp. Fungus on Crataegus Douglasii.

Septoria streptopidis Peck. On living leaves of Streptopus roseus, Prosartes trachycarpa.

MONTANA BOTANY NOTES

MARCUS E. JONES

After some four or five seasons spent in various parts of Montana, the last two being in the vicinity of Flathead Lake and the Sperry Glacier region, in connection with the Biological Station work of the State University, it seems advisable to publish at this time the new species and varieties discovered, and such changes of names as the critical field work has proved are needed. To this list is added such plants as are found for the first time within the Flathead drainage.

Polypodium vulgare L. P. hesperium Maxon. This is found sparingly from McDonald lake in the Mission mountains, to MacDougal peak, both in the alpine and Middle Temperate life-zones, and also in the Sperry glacier region. The high altitude forms are diminutive, but the plants growing around Bigfork are the normal ones and show all sorts of intergrades.

Phegopteris alpestris (Hoppe) Mett. This abounds in the alpine basins of the Bitter Root mountains at Como peak and in the Sperry Glacier region. It has doubtless been overlooked from its resemblance to Asplenium Filix foemina, and from its similar habit.

Phegopteris polypodioides Fee. This grows at Gunsight pass in the alpine basin of the lake, just south of Sperry Glacier.

Cheilanthes Feei, Moore. A form of this, with slightly larger final divisions grows sparingly at Mission Creek, and the Sperry Glacier; also found on Silloway peak by MacDougal, and at Sperry Glacier by Williams. This is wrongly referred by Rydberg to C. gracillima.

Cryptogramme Stelleri (Gmel.) Prantl. This has been found at Camass Lake by Williams, at Lake McDonald by Umbach, and by myself at Mission Creek. It grows in crevices of wet rocks, subalpine.

Pellaea densa Brack is locally abundant at McDonald lake and on Mission Creek in the Mission mountains, Middle Temperate life zone.

Asplenium viride Hudson. This is frequent on Mission Creek and at Gunsight Pass, growing in crevices of rocks, subalpine. This is what Rydberg wrongly refers to as A. Trichomanes. There are occasional stipes that are nearly black.

Polystichum Lonchitis var. scopulinum (Eaton Ferns. N. A. 2. 125 as aculeatum var.). The most marked forms of this seem surely to belong to P. aculeatum, but so far as I can find it is never found with that species, but always either with P. Lonchitis or where that naturally grows, it passes directly into that species both in Utah and Lambert Valley in the Mission mountains, where it is alpine.

Cystopteris. Underwood in the sixth edition of his fern book takes up Filix to supersede Cystopteris because Adanson in 1763 published Filix, but the genus was improperly published, as no species were named. In addition Ludwig published a genus called Filix in 1757, but also did it improperly, as there were no species named. The name Filix was taken up by Gilib in 1792 and F. bipinnata was published which is Athyrium or Asplenium Filix-foemina. Therefore the genus Filix has no standing and cannot supersede Cystopteris.

Polystichum munitum (Kaulf.) *Presl.* MacDougal seems to have gotten this at the foot of MacDougal peak, though it is far out of range.

Botrychium ternatun* var. *Coulteri (Underwood Torr. Bull. 25 537 (1898) as species). Darby and Swan Lake. Tweedy was right in placing this as a variety of B. ternatum, as it intergrades freely.

Botrychium ternatum var. silaefolium (Presl. Rel. Haenke 1 76 (1830) as species). Bigfork and Swan Lake. This also grades directly into the type.

Equisetum palustre L. Common at Bigfork, the Mission and Hot Springs; also on MacDougal peak.

Equisetum Telmateia Ehrh. This grows in very wet meadows Swan Lake, marsh east of Polson, Dayton.

Isoetes Howellii Eng. Abundant at Bigfork in overflowed flats. First collected by Prof. Cowles's party and referred to I. Bolanderi. Also by Fitzpatrick at Swan Lake.

Lycopodium Selago L. Lake McDonald, Umbach, Sperry Glacier and Blackfoot Glacier, alpine.

Lycopodium obscurum L. Belton.

Lycopodium complanatum L. Frequent in dark woods, Bigfork, Swan Lake, Belton, Gunsight Lake.

Selaginella rupestris var. densa (Rydberg Fl. Mont. 17 (1900) as species). This is common and varies directly into the type.

Selaginella rupestris var. Columbiana. Leaves and bracts rather abruptly contracted into a short awn. Stems diffuse and slender, much as in S. rupincola. Spikes sharply angled. Macrospores favose. Flathead Lake at Bigfork and Snake River, Idaho, near Weiser.

Taxus brevifolia Nutt. Sylva 3 86 t. 108 (1849). Yew. Ground Hemlock. This cannot be separated from the eastern T. Canadensis except by the very slightly looser sterile catkins. The habit is the same. It is separated from the T. baccata of Europe by the broader and blunter leaves. Our plant is a straggling or prostrate shrub 1-20 feet high, with trunk mostly less than an inch thick. Leaves dark green above and shining, lighter but not white below, narrowed at base, 13-25.5 mm. long, about 2 mm. wide, persistent, sharply acute at both ends, appearing flat, but convex above and concave below, with twisted petiole, the arrangement and color of upper side resembles that of Abies grandis, and the lower prostrate branches of which it is easily mistaken by the novice, especially since it often grows with the fir. The petiole is about 2 mm. long, the upper half being round except at tip, then it widens to an oblong and flat and adnate area which joins the leaf ridge of the twig as a prolongation of it. At maturity the narrow free part of the petiole breaks off irregularly, leaving a seeming and oblique knot simulating the cushion of the spruce, but has no scar at the tip as that does, because the leaf is not jointed to it there. The season's twigs are apple green, smooth, last season's twigs are reddish brown, the older ones browner, and at last flaking up in papery layers. The old bark of the main trunk is rather purplish beneath and flaky, like Thuya, but in few and short layers. It is a slow grower, with small rings; wood white with dark red center and inclined to be translucent, hard. The leaves are a kind of yellowish green color. The flowers for the next season form the fall before. This grows at Huckleberry Spring and along the Swan Lake road for half a mile or so; also at the Hemlocks, preferring damp and dark woods. Collected also by Elrod at the Hemlocks. The berries are red, juicy and sweet, with a resinous flavor, about 6.5 mm. long, soft and open at the tip, single in the axils. The branches with the leaves have the same flat, wand-like appearance of the fir and divide in much the same way, though they are more open and slender. It ranges northward and westward and in the Puget Sound region attains the dimensions of a tree. With us it is a low and straggling shrub forming dense thickets when several plants grow together, the branches matting down loosely with the snow. It is common in the mountains from Mission Creek to the British line and is a very bad shrub for mountain climbers because of its being so smooth and decumbent. McDonald Lake, Umbach.

ABIES, FIR.

Our two firs have the bracts concealed, being shorter than the scales. The trees are spire-like, with short branches either horizontal or drooping. Twigs stout. Wood soft and rather brittle, while light in weight. Good for finishing lumber, but not good for general purposes, soon rotting; not as resinous as most wood in this family. The young bark is not roughened, white or light and full of mostly large transverse blisters containing liquid resin. The older bark is very thick and corky and not flaking up, but growing in thick ridges.

Abies amabilis (Loud.) Forbes. Blankenship is right in saying that this species does not grow in Montana, but it does not appear that Rydberg intended to say (Fl. Mont. p. 12) that it grows in the state. He seems to have inserted it and described it so that it might be looked for. Surfaces of leaves not differing greatly in color, rather light.

Surfaces of leaves not differing greatly in color, rather light. Tips of trees lang and needle-like. Cones nearly black. Mostly alpine on slopes. **A. lasiocarpa.**

Surfaces of leaves conspicuously different in color, the upper dark-green and glossy, the lower silvery. Cones greenish-brown. Trees of the low lands along streams. **A. grandis.**

Abies lasiocarpa (Hook) Nutt. Sylva 3 138 (1849), pinus lasiocarpa Hooker Fl. Bor. Am. 2 163 (1842), Abies subalpina Eng. and var. fallax Eng. Everywhere next to timber line on the mountains (though not seen on McDonald peak) where it grows not only along streams, but on slopes and mesas. There it forms the chief forest tree, from 50 to 100 feet high, though it is intermixed with the spruce and pine. The branches are short, stiff and ragged, mostly horizontal. It also occurs sparingly at Swan Lake and along the Swan Lake road with A. grandis. It is usually a tree about 2 feet in diameter, and the leaves, especially the upper ones are short, rarely over an inch long and often little flattened and angled. MacDougal peak, Umbach.

Abies grandis Lindley Penn. Cycl. 1 30 (1833). Great Silver Fir. This is frequent along streams and rivers and at springs and swamps in the low lands and upward as far as subalpine, where it is replaced by A. lasiocarpa. It never forms a conspicuous part of the forest though it is a picturesque tree. All the branches are much drooping. Bark without roughness, except the blisters, which are 13-19 mm. long. On trees over 6 inches thick the lower bark begins to get corky and split. All but the season's twigs reddish brown, these apple green and minutely pubescent. Scar circular and slightly raised. Bark of old trees near the base (which are 2-3 feet in diameter) is 2-3 inches thick and corky, but gray, and the lines of fissuring are not so wavy as in the red fir, the areas smaller. It occurs all around the lake and in all the canons; also at Hot Springs. Tree often 150 feet high. Not common in the Sperry Glacier region.

Pseudotsuga mucronata (Raf.) Sudworth Cont. Nat. Herb. 3 266 (1895). Abies mucronata Raf. Atl. Jour. 120 (1832), P. taxifolia Britton, P. Douglasii Carriere. This is very common in moist woods everywhere and on moist slopes almost to timber line, thus forming a large and valuable timber tree. It forms about half of the forests in this region, preferring the uplands and well drained slopes. The wood is reddish, compact and tough, and heavy, not easily rotting. Trees often 4 feet in diameter. The outline is oblong to oblanceloate, with a short triangular tip. Twigs inclined to be reddish. Leaves rather thin, petioled, flat, appearing rather 2-ranked by the bending of the petiole, rather dark green, leaving oval scars. The bark is very thick and deeply cracked much higher up the trunk than in the firs. The branches are slender and inclined to droop. Tree cone-bearing all over and not at the tip exclusively as in the firs. Easily distinguished from the firs by the pendulous cones and reddish twigs, and from the spruces by the absence of tooth-like cushions on the twigs, and by the presence of an exserted, 3-toothed tongue under each scale, and by the very thick and corky bark, which is thin and scaly in the spruces. This tree is beginning to be killed out at Bigfoot by a borer. Polson, Umbach. Not seen in the Sperry Glacier region.

PICEA, SPRUCE.

Twigs smooth. **P. Columbiana.**

Twigs pubescent. **P. Engelmanni.**

Blankenship reports Picea alba Link from Belton and other localities, but all the plants so referred are P. Columbiana Lemmon, which replaces P. Parryana in our region.

Picea Columbiana Lemmon Gard. and Forest 10 183 (1897). White Spruce. Columbian Spruce. Whether this spruce can be separated from the P. alba of the east is still in doubt. The distinctions relied on by Rydberg do not hold, but the smooth twigs clearly separate it from P. Engelmanni, as well as its more narrow and spire-like outline of P. Parryi and habitat, which is that of the white spruce, namely along streams and in wet places, instead of slopes and mountain sides as in P. Engelmanni. The cones generally have entire and thick margined very broadly obovate scales and are narrowly elliptical before maturity. After opening they are elliptical and 1-1.5 inches long. The outline of the tree is lanceolate. Lower branches drooping and short. Twigs innumerable, white, shiny and smooth. Last year's ones tan colored and smooth, short and rigid, with the cushions not over 2-5 mm. high. All leaves very shortly apiculate, oblique at base and truncate. Bark of tree dark gray and rough to the twigs, lower bark scaly and thin, but the whole tree is without scaly bark up to 6 inches in diameter and is finely roughened all over. The tree is never blue like P. Parryi. It is seldom over 2 feet in diameter and often 100 feet high. The largest tree seen was 12 feet 9 inches around. It is not common, though it is found in all localities up to the subalpine. Kalispell, Williams, also Belton. Alta, Lake McDonald. Not on the Atlantic slope. Deer Lodge Valley.

Picea Engelmanni (Parry) Eng. Trans. St. Louis Acad. 2 212 (1863). Abies Engelmanni Parry same citation. Engelmann's Spruce. This is a tree with oblong outline and rather rounded top, mostly 50 to 75 feet high and 1-2 feet in diameter, much wider and shorter than P. Columbiana. The twigs are pendent, about a foot long. Leaves less rigid, spreading in all directions, acute, slender, mostly nearly straight, about 1 inch long. The cones are elliptical before opening, about 2 inches long and 1 inch wide, about a half longer than P. Columbiana, shortly rounded at both ends. Scales rather dark, straight, nearly entire in the type to somewhat lacerate, thin and with narrowed tips in ours, not evidently obovate. Twigs reddish and minutely pubescent. This is very abundant near timber line on all the peaks and on subalpine slopes is frequent. Elrod peak, Elrod. It is the only spruce on the Atlantic slope. The wood of both species is compact and hard and tough and nearly white and makes fine lumber. It is shipped as Oregon Fir all over the west. The bark is characteristic, being thin and very flaky and reddish, not forming thick ridges as in the firs, it exudes much resin, but there are few or no blisters as in the firs and is not smooth as in the firs. It is at once separable from Parry's spruce by the pubescent twigs and dark and short cones, while the twigs of the other are smooth, and the cones apple green and often 4 inches long, and the scales are thin and very lacerate, with narrow tips.

TSUGA, HEMLOCK.

The hemlocks are the most graceful and beautiful of the evergreens. Their tall and spire-like outline, with needle-like tip, and their long and drooping slender branches with quill-like twigs, 2-4 feet long pendent and dangling their clusters of cones in flat wands could be mistaken for the spruces by the casual observer. The trees are mostly 100 to 200 feet high and grow in dark and damp woods along rivulets at the bases of the mountains or alpine and are rare.

Plants of the Middle Temperate zone, cones .5-1 inch long. **T. Mertensiana.**

Alpine, cones 1.5-2 inches long. **T. heterophylla.**

Tsuga heterophylla (Raf.) Sargent Sylva 12 73 (1898), Abies heterophylla Raf. Atl. Jour. 119 (1832). Western Hemlock. This is a tree with the habit and appearance of the pyramidal forms of Juniperus scopulorum, and also

Picea Columbiana, but the tip more needle-like, habit about that of Cupressus Arizonicus. The branches droop and the fruiting twigs are pendulous in clusters. It grows along with the firs, some trees being 50 to 60 feet high with us. The branches are very many, rather dense and with many twigs. Season's twigs barely 2 mm. wide, drooping as are also all the younger twigs of 2-3 years' age, very pubescent with spreading hairs, 2-6 inches long, round. reddish yellow, the convex leaf ridges 4.5 mm. long and ending in a dark red appressed and truncate cushion about as broad as long, to which the twisted and flattened leaf petiole, about 2 mm. long is jointed. Leaf blade 13 mm. long, 1 mm. wide, entire, flat, with one dorsal groove and low convex back, and concave lower side, very dark green above and glaucous below, apex obtuse and rounded, base triangular-acute and set at an angle to the petiole, smooth. Last season's twigs light-reddish brown, 3-year-old twigs reddish brown, with papery bark splitting between the leaf ridges and flaking up like birch bark, the leaf cushions falling off with them. Twigs that are 13 mm. thick also have reddish brown papery bark scaling up somewhat. The older bark scales up like the spruce, but is more shreddy, like the Arbor Vitae. Cones apple green, pendulous on twigs 1-2 inches long, about 1 inch long, 11 mm. thick, elliptical-lanceolate, acute, smooth and waxy, but apparently puberulent when young. Scales 13 mm. long, elliptical-oval, with very narrow and reddish and entire margins. Seeds very small, 2 mm. long. Wings 4 to 6 times as long and very thin and rounded. Bracts not visible in the green cones. Wood white and soft and very flexible, with red center. This is very rare in our region so far as known, A few individuals grow at the Hemlocks at the foot of MacDougal peak near Echo Lake and at Swan Lake. It also abounds in the Sperry Glacier region. It does not grow on the Atlantic slope.

Tsuga Mertensiana (Bong.) Carrierė Trait. Conif. Nouv. Ed. 250 (1867). Pinus Mertensiana Bong. Mem. Ac. St. Pet. 6 2 45 (1832). Tsuga Pattoniana Eng. Black Hemlock. Leaves 13-25.5 mm. long, angular, acutish, narrowed below, often arched, keeled on both sides, unequal and appearing as if in clusters. Cones 1.5-2 inches long, cylindrical, 13-17.5 mm. thick. Seeds 5 mm long, with an obliquely abovate wing. This has been reported from the Sperry Glacier region, McDonald peak and Bitter Root mountains, but it is doubtful if it grows east of the Cascades. It has probably been confounded with the longer coned forms of the above. The Sperry Glacier species is not Mertensiana.

Blankenship in his additions to the Montana flora quotes Tsuga Mertensiana records from various Government reports as occurring on the high mountains. All these records are errors, for Picea Columbiana, whose cones resemble the Tsuga. No Tsuga grows at high elevations in Montana. They all belong to the Middle Temperate life-zone.

JUNIPERUS, JUNIPER, CEDAR.

Alpine shrubs mostly, tufted from the root and prostrate or widely spreading with sharp and prickly leaves about 12 mm. long. Berries in the axils. **J. communis.**

Not alpine. Leaves scale-like (sometimes needle-like in Virgiana).

Prostrate or decumbent at base, shrubs, **J. Sabina.**

Trees or shrubs, with distinct and erect trunks. Berries terminal.

Leaves with entire margins, in pairs. **J. Virginiana.**

Leaves with plainly denticulate margins, mostly in threes. **J. occidentalis.**

Juniperus communis L. 1040. The type is a small tree with a trunk, and does not occur with us.

Juniperus communis var. **depressa** Pursh Fl. 2 646 (1814). Depressed variety. This is the common form at low elevations growing in the open woods on flats where the stems are many from the root and decumbent at base and then ascending 3 to 4 feet high, forming a kind of bowl shaped mass 6 to 10 *feet in diameter. Common* all along the eastern side of the *Lake in the Middle Temperate life-zone.* Occasional in the Sperry Glacier *region, especially on the Atlantic slope.*

Juniperus communis var. **montana** Ait. Hort. Kew 3 414 (1788). J. Sibiriea Burgsti., J. communis var. alpina Wall. Alpine variety. This forms dense mats at and near timber line and is mostly prostrate throughout and usually has shorter and blunter leaves. The berries of both the varieties are blue with a white bloom and are barely edible. The species has little use in Montana, though the branches make good floors for beds. The plants have a strong odor when bruised and produce juniper oil in abundance when distilled. The berries form a portion of the food of grouse at high elevations and the mats form the best of shelter from enemies and the weather. It grows best on steep ridges and exposed slopes and cliffs. MacDougal peak, MacDougal; also Umbach. It is common.

Juniperus Virginiana L. 1039. Red Cedar. Red Juniper. This is the characteristic tree of the Lake shores, being found everywhere just at the storm line. It also grows on subalpine cliffs straggling over the rocks. Along the shores it occurs in two forms, the more common one being a bushy and rounded clump with one or more trunks 10 to 20 feet high growing on rocks or shallow soil. Where the soil is deep it assumes the proportions of a tree even 75 feet high and often pyramidal in outline. It varies in thickness from a few inches to almost 2 feet. The bark is rather thin and dark. The branches are smooth and olive colored and do not flake up at all for several feet in length, then they flake slowly, but not at all as in the variety which grows in more arid conditions and therefore flakes up more quickly. The inner bark is dull and the wood of the twigs white to the core. The spray is fine and open. Berries about 2 mm. wide and blue when ripe. The wood of the old trees has a narrow white band near the bark, the rest is dull red and not purplish as in the variety. The odor is strong and aromatic. The texture of the wood is compact, very fibrous and splitting into very slender splinters, very flexible, heavy. It makes the best of fire wood, good posts, is rarely large enough for lumber and is much used as an insect exterminator because of the strong odor. The bark of the main trunk is not evidently shreddy, but is deeply cracked in narrow ridges, and it never hangs in long shreds floating in the wind as on the white juniper. Where the bark cracks up on the twigs it does so in rectangular pieces, not in papery shreds. The distinction of rounded top separating this from the variety amounts to nothing. The ripening of the berries is indifferently annual or biennial, though in the typical species it is more nearly annual. The only distinction that amounts to anything between this and the variety is the finer spray, smaller berries and dull purple wood. Also at McDonald peak at 5,500 alt.; Wild Horse Island, Elrod; Bigfork, Umbach. Not seen in Sperry Glacier region.

Juniperus Sabina L. 1039. Creeping Juniper. This belongs to the Virginiana section and is creeping, flat on the ground for the most part. It grows on dry slopes, but does not seem to be nearer our region than the Atlantic slope, except at Garrison and Upper Marias Pass and Deer Lodge Valley.

Juniperus Virginiana var. **scopulorum** (Sargent Gard. and Forest 10 420 (1897) as species). This variety does not grow in the Flathead region unless it occurs on the west side on rolling hills. The wood is bright purple, the berries about 4.5 mm. wide, the spray much shorter and a little thicker, and the bark of the twigs flaking up except for a short distance near the ends into small blocks and leaving the purplish under bark exposed. It abounds on dry hills and cliffs where the rainfall is less than 20 inches per annum throughout eastern Montana and southward through Idaho. In Utah it is found only in the mountains on cliffs and slopes. It is mostly with rounded top, but is occasionally pyramidal, but rarely reaches 50 feet high then. The differences between the type and variety are only such as would occur in a moister climate. There is a Coast form of this plant along the Sound whose *relationship* is not yet fully established, but it is probably only the most *developed form, due* to better soil and still more humid climate.

Juniperus occidentalis Hooker Fl. Bor. Am. 2 166 (1840). Western White Juniper. This has not yet been reported from our region, but is likely to grow west of the Lake on the dry hills. It is characterized by the thick twigs, large berries, compact spray, rounded apple tree-like top and very stout and erect trunk 1 to 2 feet thick, as well as by the leaves being in threes.

THUYA, ARBOR VITAE.

Thuya plicata Donn Hort. Cantab. Ed. 6 249 (1811). T. gigantea Nutt. Giant Cedar. Arbor Vitae. Cedar. This is a very tall and graceful tree, outline conical, or linear-subulate in cross section, with spreading and much drooping branches. The scale-like leaves green and shining, acuminate, rather pubescent. Comes clustered toward the ends of the twigs, 13 mm. long, the scales with a thin and acute mucro. Wood is fine grained, very flexible and soft, light colored, reddish at center, durable, splitting readily into fine flakes and much used for shingles. With us it is a slender tree rarely a foot thick and 100 feet high, growing on wet north slopes along with the larch and fir in the shade. The bark shreds up into long and thin flakes 1 to 2 feet long, which are reddish. The upper stems smooth and light brown. Branches many and slender. It is at once recognized by the scale-like leaves arranged on branches, forming great flattened wands, and by the cones. Huckleberry Spring, on the Swan River road. This is sold as white cedar by the lumbermen throughout Montana. Common at McDonald Lake in the Mission Mountains. Not seen on the Atlantic slope.

At both lakes there are magnificent forests with some trees 4 feet in diameter.

CHAMAECYPARIS, YELLOW CEDAR.

Chamaecyparis Nootkatensis (Lamb). Spach. Hist. Veg. 11 333 (1842). Cupressus Nootkatensis Lambert Gen. Pin., 2 18 (1824). This has been reported from near our region, but is probably an error for the Thuya.

PINUS, PINE.

- Leaves less than 5 in each cluster. Bark rough.
  - Leaves in twos, 2-3 inches long. Cones persistent for years, small, about 1.5-2 inches long, obliquely-triangular-ovate when closed. Slender trees with many and mostly whorled branches. **P. contorta.**
  - Leaves in threes, rarely in twos, about 6 inches long. Cones oval 3-4 inches long, dark-purple. Branches seldom opposite, few, large. Very large trees **P. ponderosa.**
- Leaves in fives. Bark smooth on all the upper part of trees, very resinous. Wood soft and white, rather brittle.
  - Cones ovate to almost round, very dark, rarely 3 inches long. Low and scraggly trees growing in rocky places in subalpine situations. **P. albicoulis.**
  - Cones nearly apple-green, cylindrical, 4-8 inches long.
    - Low and scraggly trees, widely branched. Leaves rigid, dark-green. Branches few and large. **P. flexilis.**
    - Tall and stately trees with slender, weak and light-green leaves. Bark oak-like. Branches whorled and many. **P. monticola.**

Pinus contorta Douglas in London Arb. Frut. 4 2292 f. 2210, 2211 (1838). What corresponds partly with the type of this species is a small and scraggly tree growing at timber line on McDonald peak, and probably elsewhere. It has small and very oblique cones not opening for several years after maturity and slender leaves 1 to 1.5 inches long. The type is a tree of the wet coasts of the Sound in a very different life zone. Upper Marias Pass, Lake Louise.

Pinus contorta var. **Murrayana** (Murr.) Eng. Bot. Cal. 2 126 (1880), Pinus Murrayana Murr. Bot. Exp. Oregon 740 t. 3. f. 2. (1860). Lodgepole Pine. This is a strict and slender tree with tapering trunk, growing in dense thickets and singly all over the mountains to timber line in dry places, horizontal, slender, whorled branches. Cones clustered, about 2 inches long, with strong knobs and slender prickles. The bark is thin and scaly and light-brown, and rough even to the twigs, not conspicuously resinous. Leaves 2 to 3 inches long. Outline of tree is lanceolate with an acuminate tip. This is the most common evergreen in the region taking it as a whole. There are few places where it has reached the dimensions of a lumber tree because of the frequent fires, but back of Yellow Bay it forms immense thickets over square miles of land, growing so thickly that it is difficult to force one's way through it afoot. It is everywhere on the slopes of McDonald peak, is very abundant on the uplands back of Bigfork going up to the limit of the subalpine at 5500 feet. It is occasionally 150 feet high. The wood is tough, hard, compact and reddish, and when large enough makes fine lumber. It is much used for poles for fencing, for posts and the like. Everywhere to the top of the mountains in the Bitter Root valley. Occasional on both slopes in the Sperry Glacier region.

Pinus ponderosa var. **scopulorum** Eng. Bot. Cal. 2 126 (1880). Yellow Pine. This is a magnificent tree 100 to 150 feet high, with straight trunk tapering but little, the lower branches falling early and only here and there a great branch straggling off, trunk often 100 feet long without a branch and 2 to 6 feet in diameter, with brick-colored, thick, flaky bark cracking up into great flat areas 2 to 4 inches wide and a foot or more long. The very slender leaves are about 6 inches long in swabs at the ends of the twigs. The cones before opening are oval-olong, 3 to 4 inches long, but on opening are about oval-ovate, dark colored. Prickles stout and incurved. Wood rather yellowish, compact, tough, heavy. Leaves often in twos. The cones and leaves vary greatly. This is the great lumber tree of the region. It abounds on the mainland on tablelands and slopes to the subalpine at .5500 feet alt. in dry places and on all the shores and islands of the lake. It never grows in thickets, even the seedlings do not grow close together as with the lodge-pole pine. Bigfork, Umbach. Everywhere to the top of the mountains in the Bitter Root valley.

Pinus albicaulis Eng. Trans St. Louis Acad. 2 209 (1868). White-barked Pine. Bastard Alpine Pine. This grows at high elevations at and near timberline on all the mountains on the edges of rocky meadows and slopes and ridges. It is a scraggly tree, generally with the trunk dividing into two or more great limbs which are tortuous or curved and sparingly branched with short and thick twigs and smaller branches whose swollen bark is full of pitch. The leaves form narrow swabs at the ends. The nearly black cones are single to clustered near the ends, and are heavy but small. The main trunk is a foot or two thick with rather thin bark cracking into oblong areas flat on the top much like the oak. The wood is soft and white and full of resin and very brittle, of little value save for fuel. Trees rarely over 50 feet high growing along with the alpine fir and red fir. Common at timber line on both slopes in the Sperry Glacier region.

Pinus flexilis James Long's Exp. 2 35 (1823). Bastard Pine. This is not yet known nearer than Deer Lodge valley. Its cones are narrow and over twice as long as in albicaulis and the tree grows in the Middle Temperate life zone mostly but in other respects much resemble it.

Pinus monticola Douglas in Lamb. Desc. Pin. Ed 2, 3 27 t. 87 (1837). White Pine. This is the most magnificent pine of them all. It often grows to 200 feet high, with a straight symmetrical and clean trunk, with thin (except at base) and oak-like bark. It is often 6 feet in diameter but is still a slender tree. It has an airy apearance because of the rather long internodes and the almost thread-like and glaucous leaves 2 inches long.

The cones are resinous, light but ofen 8 inches long, few and almost always at or near the tip of the tree. The bark is olive-gray and smooth on all the branches and even the trunk for many feet down. Bark of the main trunk below is light-gray, cracked into small rectangular and oblong areas 1 to 2 inches long which are not flaky and never over an inch thick and flat-topped. Outline of tree is linear with an acuminate tip. It branches like the lodgepole pine but is more open and with branches longer and flexible. It grows along the Swan Lake road sparingly in moist places and in the fir forests near the Hemlocks in the most magnificent proportions. It is remarkably free from knots. The wood is white and soft. It is considered the best timber tree of all, but is not plentiful. Not found on McDonald peak nor on any of the islands. Lake McDonald, Umbach. Locally abundant in the Lake McDonald region.

LARIX, LARCH, TAMARACK.

Alpine, twigs and bud scales woolly. **L. Lyallii.**
Plants of the Middle Temperate life zone. Twigs and scales smooth. **L. occidentalis.**

Though the larch differs superficially from Picea in a marked degree in the deciduous and fascicled secondary leaves, yet it is closely related to it in all permanent characters as is shown by the development of the young plants and the character of the primary leaves. Its arrangement with the pines is a wholly artificial one for ease in classification.

Larix Lyallii Parl. Enum. Sem. Hort. Reg. Mus. Fl. 259 (1863). Alpine larch. This tree grows at and near timber line on the high peaks. It is seldom 100 feet high and branches rather low down into one to three large and candelabrum-like divisions which are mostly erect above the curved base. The trunk is large for the height and straight, seldom making more than one length of good lumber. The bark and wood are much the same as in the western larch. It grows on rocky slopes and among glacial boulders, never in wet places. In our region it has not been found on the Flathead Lake side of any of the ranges but occurs on the eastern side of the Swan range in the alpine basins but sparingly. It has been found on Elrod peak, Mt. Lo Lo, also by Jones in the main range west of Hamilton. It also occurs on Mt. Haggin back of Anaconda and probably southwestward to the Sawtooth and Seven Devils mountains, Idaho and the Blue Mountains or Wallowas of eastern Oregon. It extends northward into British America and westward. Not seen in the Sperry Glacier region.

The following field study of Larix Lyallii growing on Como peak was made this year. Subalpine. Young trees much like L. occidentalis but more widely branched. Bark rough and cracking up into irregular and thick flakes like Pinus Murrayana on the base of trees that were only 4 inches thick. Upper bark light gray and smooth, powdery or granular. Two-year-old twigs the same in color and with thin hair-like flakes or fibrous shreds. Last year's twigs chestnut-colored and woolly. Season's twigs were woolly and green and with single leaves as in the other species. Regular leaves needle like and a little tapering at base, very soft, about an inch long. Cones erect even when the twigs are pendent. Scales erose and puberulent at tip, deep purple. Branches very slender and pendent often. Outline of old trees ovate. Branches large, dichotomously several times branched. Habit more that of Pseudotsuga but more open. Branches either ascending or drooping. Trunks sometimes forked and candelabrum-like, but mostly simple.

Larix occidentalis Nutt. Sylva 3 143 t. 120 (1849). Western Larch. Tamarack. The young season's branches have raised ridges along the stem like the spruce, which end abruptly in an oblique scar to which the primary leaves are jointed, but this scar is not horizontal at the end of a short and woody and persistent pedicel as in the spruces, but the leaves of both are single in a place like the firs. The second year the twigs are roughened by these now leafless ridges though otherwise smooth and are tan-colored. After the twigs are two years old they are covered by resinous particles like warts and are dark-gray or brown. The outline of the tree is linear-lanceolate and it appears sparsely branched with relatively very short branches which are often clustered in bunches, mostly alternately, and mostly drooping. Twigs either erect or pendulous. In young trees especially the twigs are often several feet long and droop like the weeping willow forming very beautiful and symmetrical trees. The tree is much infested with mistletoe which produces great knobs from which arise innumerable branchlets. Season's twigs about 2 mm. thick, dull-red, very slender, a few inches to a foot long as a rule, slightly pubescent, arising from the wart-like knobs of the previous year, except the terminal twig which arises from the bud of the previous year, but even it has at its base the rosette of secondary leaves which is characteristic of the knobs and also has the knob there. The second year the lateral buds of the first year produce rosettes of many leaves and also thicken into warty knobs about 6.5-9 mm. long and wide which persist in the stem indefinitely and give it its very knotty appearance. The third year these knobs develop twigs from the center and a second rosette of leaves at the base or produce sterile or fertile cones with a rosette of leaves at their base, or often produce only another rosette of leaves. The twigs of the season have the basal rosette leaves about 2 inches long, 6.5 mm. wide and 3 mm. thick, they are obtusely 4-angled, needle-like, but a trifle wider above and with a very short point at the rounded tip. These leaves gradually pass into the primary leaves of the twigs which are about 1 inch long above and nearly the same width throughout and with a short and aculeate tip. These leaves are alternate, one in a place, terminating a leaf-ridge which is exactly like hemlock (that is convex on the back and chestnut-colored, ending in a truncate projection which stands out its width above the end of its attachment where it is jointed squarely to the leaf which is sessile and without a petiole, and is deciduous, this projection after a year or two being only a knob in the bark and thus differing from the spruce). Therefore the larch and hemlock are the nearest related, and both are closely related to the spruce. The cones mostly fall when ripe but sometimes persist a year, especially when they produce a rosette of leaves at the tip which occurs frequently. Rarely they produce season's twigs from the tip and the upper and sometimes the lower bracts are altered into leaves, but with the center of the cone still seed bearing. The cones are 1-2 inches long, .75-1 inch wide, rounded at both ends. The bracts are tridentate and with the central tooth variously prolonged but the body of the bract is not exserted, bract red to purple at least at base. Scales nearly oval, about 9 mm. wide, the tips recurved a trifle and a little erose, about 13 mm. long. Wings of seeds half-ovate and as long as the scales, very thin, rounded. The cones ripened on Sept 1st, this season at Bigfork but at Coeur d'Alene Lake they were not ripe two weeks later though the elevation was much less, they seem to mature at once after frost. The bark of the older twigs is smooth and drab-colored except for the darker areas representing the old leaf-ridges which gradually widen and at last break into shallow cracks exposing the reddish under bark and letting the bark flake up in one thick layer. With age the bark gets rougher and more flaky and darker till the outer flakes fall off and leave it reddish. On the main trunk the bark is scaly and thin above, but on old trees it cracks into large and flat areas 2 to 4 inches wide and 6 to 18 inches long, reddish. The old trees have conspicuously brick-colored bark in great areas like the yellow pine but brighter. The tree is often 200 feet high, straight, with trunk tapering but little, the outline is linear-lanceolate. The branches are so small that they do not leave the wood knotty. The wood is rather reddish, soft, compact, finely grained and straight and splits readily in thin flakes. This tree forms about half of the forest of the eastern side of the Lake and by far the most lumber. The trees grow close together in dense forests and are often 4 feet in diameter. They prefer moist soil on north slopes or along bottoms and extend up to about 5500 feet altitude or the limit of the Middle Temperate zone. It is less common at Dayton, Hot Springs and McDonald peak than at Bigfork. Common in the Sperry Glacier region. Not seen on the upper Bitter Root.

Potamogeton Friesii Ruprecht. Polson Swamp.

Andropogon scoparius Mx. Dayton. This is the first time it has been reported west of the Atlantic slope.

Stipa minor (Vasey) Scribner. Common on low prairies Bigfork and Wild Horse Island.

Stipa Nelsoni Scribner. Monida, Alta, Blackfoot Glacier.

Agrostis exarta Trin. Alta, Belton.

Polypogon Monspeliensis (L.) Desf. Ravalli.

Calamagrostis neglecta (Ehrh.) Gaertn. Evaro, Alta.

Calamagrostis blanda Beal. Daphnia Lake at Bigfork. Too close to C. Canadensis.

Calamagrostis rubescens Buckley. Bigfork, Swan Lake, Bull Island.

Trisetum cernuum Trin. Bigfork, Swan Lake.

Trisetum canescens Buckley. Bigfork, Alta, Evaro.

Deschampsia calycina Presl. Ronan.

Spartina gracilis Trin. Polson.

Poa purpurascens Vasey. Sperry Glacier.

Poa reflexa V. & S. Sperry Glacier.

Poa alpicola Nash. Blackfoot Glacier.

Poa leptocoma Trin. Blackfoot Glacier.

Poa pudica Rydberg. Blackfoot Glacier.

Poa interior Rydberg. Sperry Glacier. A doubtful species.

Poa crocata Rydberg. Sperry Glacier.

Poa Lettermanni Vasey. Sperry Glacier.

Poa Howellii V. & S. Daphnia Lake at Bigfork.

Poa laevigata Scribner. Deer Lodge valley, Sperry Glacier.

Poa Nevadensis Vasey. Alta.

Poa brachyglossa Piper. Monida, Alta, Evaro.

Poa confusa Rydberg. Garrison.

Poa Olyneyae Piper. McDonald Lake Mission Mts., Darby.

Poa acuminata Scribner. Lambert Valley.

Poa annua L. Ronan, Missoula, Lake McDonald.

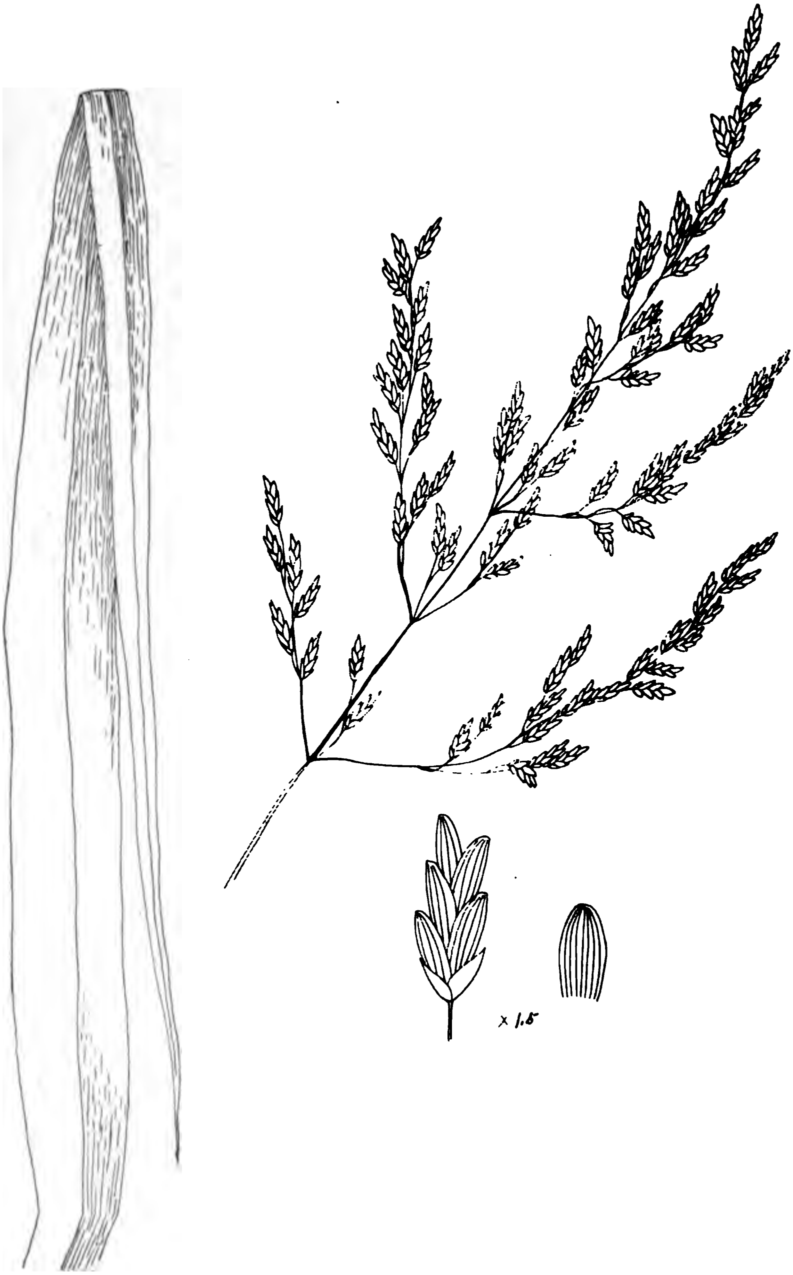
Glyceria elata (Nash Fl. Mont. 54 (1900) as Panicularia). Bigfork.

Glyceria pauciflora Presl. Ronan, McDonald Lake in the Mission Mts.

Glyceria borealis Piper. Swan Lake, Bigfork, Yellow Bay, Upper Marias Pass, Ronan.

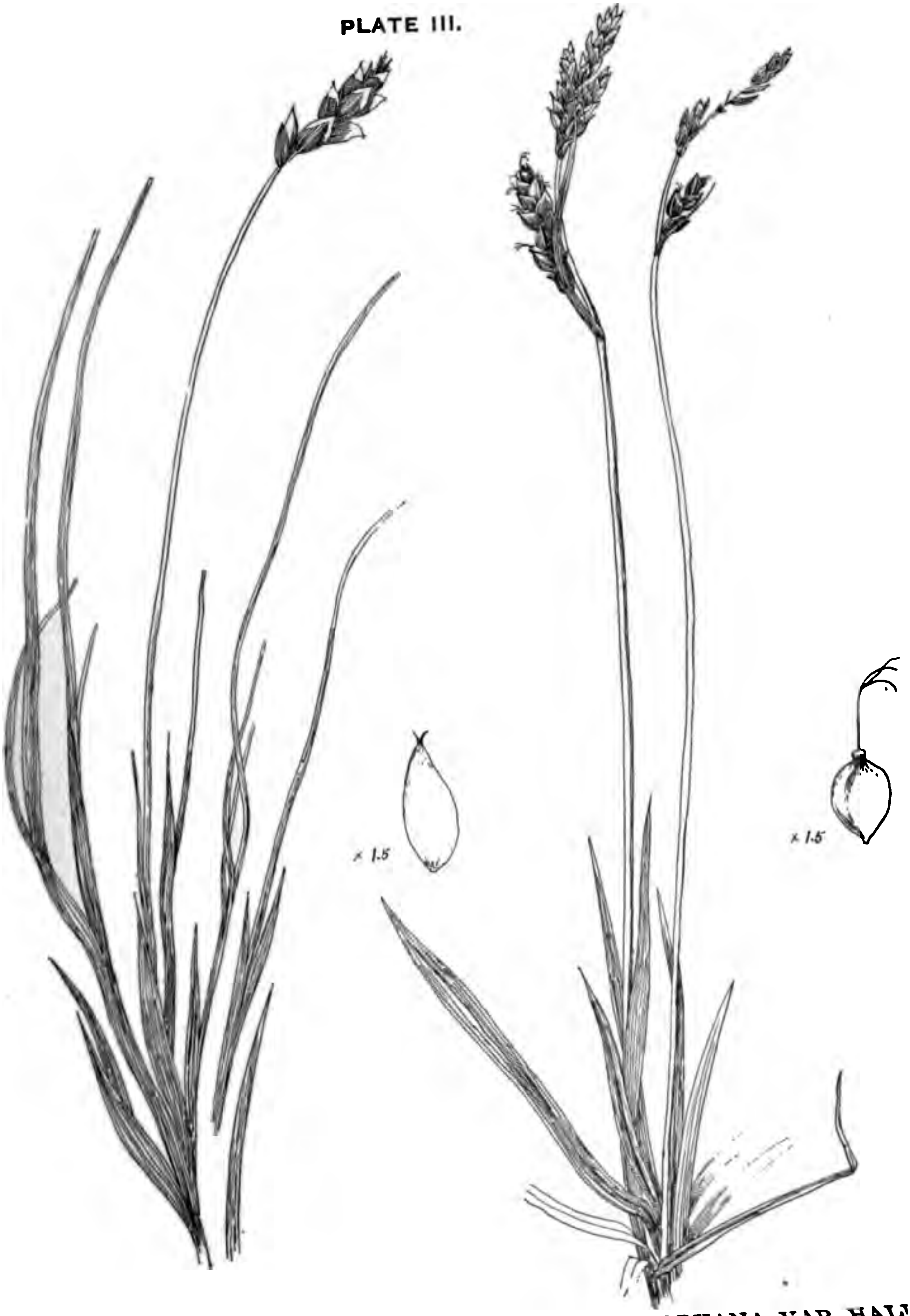
Glyceria flavescens n. sp. This is close to G. grandis, but shorter and more rigid, stems 13 mm. thick at base, erect, 2.5-3 feet high not creeping at base. Even the upper sheaths nearly as long as the internodes which are short, making the stems very leafy. Upper leaves 6 to 12 inches long and nearly 13 mm. wide, shortly acuminate, smooth except on the scabrous edges, yellowish-green, a little paler below but not glaucous. Panicle scarcely exserted, obovate-cuneate, very dense, erect, with several erect rays at each joint which branch repeatedly, only the upper branches spreading. Spikelets linear-lanceolate, acute, about 11 mm. long, about 5-flowered, grennish-yellowish. Glumes hyaline, white, turning tawny with age, the upper 3-nerved at base. Lemma narrower and a trifle longer and less scabrous than in G. grandis, not turning purple. This has the habit of Phragmites and grows in large patches in bogs. Gathered at Swan Lake Aug. 24, 1908 while G. grandis at the same place was all out of bloom and even the seed fallen two weeks earlier. It differs from G. grandis in the swab-like panicle, lutescent flowers and leaves, broader

PLATE II.



GLYCERIA FLAVESCENS JONES N. S.

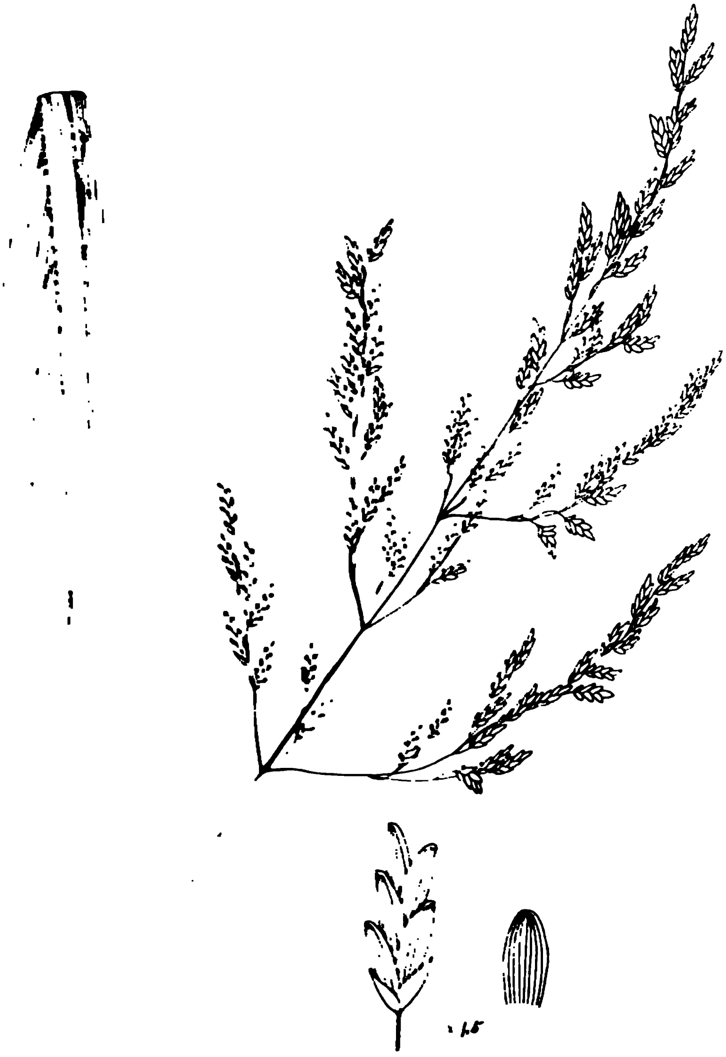
PLATE III.



CAREX STANTONENSIS JONES N. S.

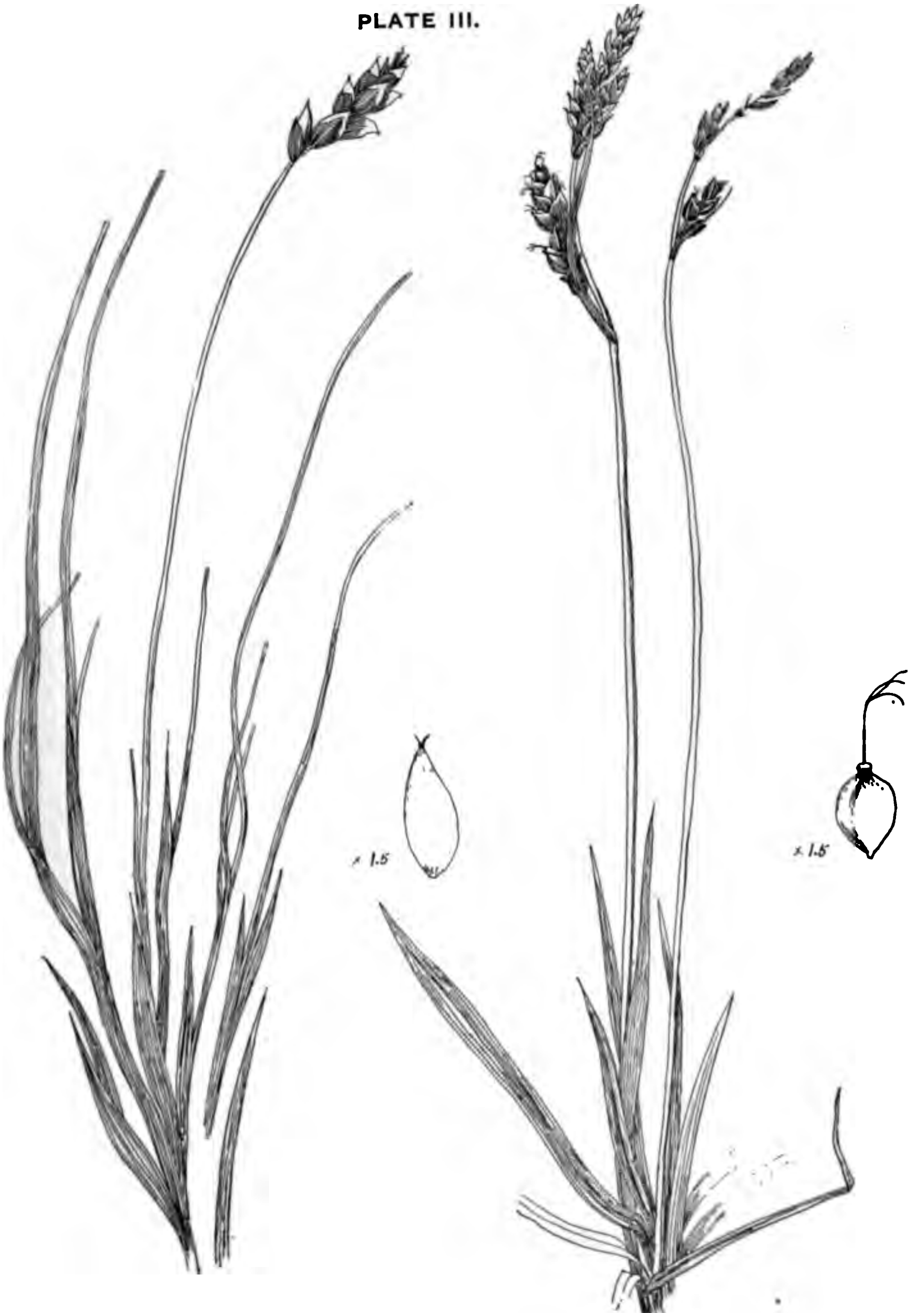
CAREX PARRYANA VAR HAL
BAILEY

PLATE II.



FLAVESCENS JONES N. S.

PLATE III.



CAREX STANTONENSIS JONES
N. S.

CAREX PARRYANA VAR HALLII
BAILEY

and shorter leaves, short internodes and very leavy stems, and much later flowering season. Middle Temperate life zone.

Festuca Hallii (Vasey) Piper. Bigfork, MacDonald peak.

Bromus Pumpellianus Scribner. Alta. Blackfoot Glacier, Bigfork.

Bromus Richardsoni Link. Bigfork, Swan Lake, Ravalli. Also the var. pallidus (Hook.) Shear, MacDougal and McDonald peaks, Wild Horse Island, Whitefish and Bigfork.

Bromus tectorum L. Missoula, Colville.

Bromus marginatus Nees. Bigfork, St. Ignatius Mission, Ronan, Ravalli Alta, McDonald Lake in the Mission Mts.

Melica stricta Bolander. Blackfoot Glacier.

Melica bella Piper. Alta.

Agropyron occidentale Scribner. Bigfork, Ronan, McDonald Lake in the Mission Mts., Upper Marias Pass, Browning.

Agropyron lanceolatum S. & S. Wild Horse Island.

Argopyron biflorum (Brign.) R. & S. Alta.

Argopyron Scribneri Vasey. MacDougal Peak.

Elymus triticoides Buckley. Ravalli, Blackfoot Glacier, Browning, Upper Marias Pass.

Elymus glaucus Buckley. Ravalli.

Elymus Canadensis L. Bigfork, St. Ignatius Mission, Yellow Bay, Wild Horse Island, Upper Marias Pass.

Scirpus riparius (R. Br.) Spreng. Monida.

Scirpus robustus Pursh. Bigfork, Hot Springs, St. Ignatius Mission.

Scirpus microcarpus Presl. Darby.

Scirpus microcarpus var. **robrotinctus** (Fernald Rhodora 2 20 (1900) as species. This hardly deserves varietal rank, all sorts of intergrades occur constantly. Alta, Bigfork, Swan Lake, St. Ignatius Mission, Hot Springs, Polson Swamp, Bull Island, Common.

Eriophorum gracile Roth. ..Sperry Glacier.

Eleocharis rostellata Torr. Hot Springs.

Carex Deweyana var. **sparsiflora** Bailey. Yellow Bay in damp and dark woods.

Carex nardina Fries. This plant is very common on all the alpine peaks and rocky meadows of the Sperry Glacier region, and in Lambert Valley in the Mission Mts. Though it agrees with other material from the Cascades sent out by the Gray Herbarium, it does not accord with the usual character given this species. In case it should prove distinct it may bear the name **Carex Stantonensis.** Densely caespitose, with many large and brown sheaths like C. filifolia, and with thick crowns. Root leaves many, filiform, channeled, smooth, truncate, rigid, erect, .5 mm. wide, about 4 inches long and as long as the stems which are filiform. Spike single, inclined to be clavate and narrowed below, but acute at tip. The two lowest perigynia contiguous, the rest imbricated closely. Spike staminate at tip and with few stamens, 13 mm. long, 5 mm. wide. Bracts none. Scales ovate-oval, acute, fully 2 mm. long, chestnut-colored but with lighter midrib, closely investing the perygynia and fully as wide, very thin, with entire edge. Perigynia closely appressed but with tip inclined to turn out, manifestly inflated and with papery covering, about a third longer than the akene and inclined to wrinkle lengthwise as if nerved, tip a little oblique, with very short oblique beak, not cleft down the outside to speak of and nearly entire. Perigynia white except the chestnut-colored tip, about as long as the inflated scale, smooth except the scabrous edges above and near the tip on the back, apparently plano-convex, not winged, oblong-ovate. This is manifestly a close ally to C. Lyoni but differs in the much broader scale, while the perigynia are wanting in the mature state. It is also near to C. rupestris but the stigmas are two and not three and the perigynia are not smooth above as in that species. Collected by Williams on a mountain above Stanton Lake, Aug., 1894 and distributed as C. Pyrenaica.

Carex gravida Bailey. Swan Lake.

Carex conjuncta Boott. Polson Swamp, Whitefish, Sand Point, Idaho.

Carex diandra Schrank. Ours is the var. **ramosa** (Boott) Fernald. Bigfork, Swan Lake, Rost Lake, Ronan, Alta.

Carex stenophylla Wahl. Upper Marias Pass, Deer Lodge Valley.

Carex scirpoides Schkr. Bigfork, Swan Lake, MacDougal peak.

Carex scoparia Schkr. Evaro.

Carex Liddoni Boott. Garrison, Alta, Evaro.

Carex adusta Boott. Ronan.

Carex leptalea Wahl. Bigfork, Rost Lake, Swan Lake, Bull Island, Yellow Bay.

Carex scirpoidea Mx. Lambert Valley, rather common in the Sperry Glacier region.

Carex aquatilis Wahl. Polson Swamp, Monida, Whitefish, Silver Bow.

Carex rigida Good. Lima, Monida.

Carex lenticularis Mx. Bigfork, Swan Lake, Sand Point, Idaho.

Carex acutina Bailey. Blackfoot Glacier,, Alta, Swan Lake.

Carex Nebraskensis Dewey. Evaro, Ravalli, Bigfork, Yellow Bay, Hot Springs, Monida.

Carex Parryana Dewey var. **Hallii** (Olney) Rydberg. Whether this is a good species I am not able to say at present. Prof. Bailey also regarded it as a variety of C. Parryana and called it var unica. A detailed description of it is appended.

This appears to be near C. Pennsylvanica. Stems leafless except at very base, 1 foot high, smooth, obtusely-3-angled, filiform, 1 mm. thick, erect and stiff, light-green. Leaves several basal, 3 inches long, 4 mm. wide at base, linear-subulate, yellowish-green, flat, rigid. Bracts enlarged, chestnut-colored and scale-like at base, sheathing, the lowest with a setiform green bristle about 1 inch long below the lowest spike, the others much reduced but present. Terminal spike 19 mm. long by 2 mm. wide, sessile, all staminate, with oval mostly obtuse scales which have broad hyaline, and lacerated edges and chestnut-colored center, 2 mm. long. Pistillate spikes contiguous, about 3, the uppermost at base of the staminate one and very small and few-flowered, 4.5-6.5 mm. long, 2 mm. wide, sessile, the others longer, 13-19 mm. long and 6 to 15 flowered, loose and cery narrow, 2 mm. wide, the scales reaching about to the middle of those above on the lower part of the spike. Lowest spikes on filiform peduncles but erect, the peduncles not longer than the spikes except when the lowest spike is subradical, when the peduncle is 3 to 4 inches long. Scales very broadly ovate, barely acute to cuspidate, dark-chestnut-colored, with white and hyaline edges, about 2 mm. long, embracing the oval, very convex and smooth (but papillose with oblong bosses) perigynia, which are abruptly contracted at both ends to a short beak or stipe, faintly-several-nerved, tip with serrate edges, mostly green, 1.5 mm. long. Monida on dry prairies. Middle Temperate life zone. This differs from C. Parryana in the sheathing bracts and smooth appearing perigynia, etc.

Carex Pennsylvanica Lam. Alta.

Carex Pennsylvanica var. **pinicola.** Leaves 11-15.5 mm. wide. Pistillate flowers more numerous, plants more robust. Alta among pines on dry hillsides. Middle Temperate life zone.

Carex Idahoa Bailey. Monida, Butte, Ryan's Lake.

Carex polygama Schkuhr. Rost Lake, Monida, foot of MacDougal peak.

Carex atrata L. Sperry and Blackfoot Glaciers.

Carex atrata var. **ovata** (Rudge) Boott. Sperry and Blackfoot Glaciers. Ours answer well to C. chalciolepis but are not all copper colored.

Carex Mertensii Prescott. Blackfoot Glacier.

Carex alpina Swartz. *Sperry Glacier,* McDonald Lake in the Mission ***Mts., Darby.***

Carex physocarpa Presl. Bigfork, Evaro, Alta, Ravalli.

Carex vesicara L. Bigfork, Polson Swamp, Alta.

Carex monile Tuck. Common at Bigfork, Polson Swamp, Monida, Hot Springs.

Carex retrorsa Schw. Bigfork, Rexford.

Carex retrorsa var. **Hartii** (Dewey) Gray. Polson Swamp and Swan Lake.

Carex lurida Wahl. Bigfork, Swan Lake.

Juncus Balticus var littoralis Eng. Wild Horse Island, Polson Swamp.

Juncus Drummonlii E. Meyer. Common in alpine meadows and on rocky ridges, MacDougal peak, McDonald peak, and on all the peaks of the Sperry Glacier region.

Juncus Drummondii var. **Parryi** (Eng. Rev. Junc. 446 (1866) as species). Como peak, McDonald Lake, Mission Mts.

Juncus triglumis L. Sperry Glacier.

Juncus Dudleyi Wiegand. This is one of the few segregates from J tenuis that seems to hold. Bigfork, St. Ignatius Mission, Sand Point, Idaho.

Juncus Greenei Oakes. Whitefish.

Juncus tenuis var. **anthelatus** Eng. Darby.

Juncus castaneus Smith. Blackfoot Glacier.

Juncus acuminatus Mx. Polson Swamp and Sand Point, Idaho.

Juncus alpinus Vill. J. truncatus Rydberg. Ours is the var. insignis. Common on the flats all around Flathead Lake and Swan Lake.

Juncus Nevadensis Wat. Alta, Hamilton, Wild Horse Island, Polson Swamp.

Juncus Columbianus Coville. Browning.

Luzula spicata (L.) Dec. Gunsight Pass and Sperry Glacier.

Luzula parviflora (Ehrh) Desv. Lambert Valley.

Luzula Piperi (Coville in Piper Fl. Wash. (1906) as Juncoides) Alpine meadows, MacDougal peak, Sperry Glacier, Alta.

Acorus Calamus L. Abundant at Polson Swamp and adjacent mainland, if introduced it must have been long ago.

Xerophyllum tenax (Pursh) Nutt. This abounds on all the mountains from Alta and the Mission mountains northward. It includes X. Douglasii Wat. There is great variability in the flowers.

Tofieldia glutinosa (Mx.) Pers., **T. intermedia Rydberg.** Sperry Glacier.

Tofieldia palustris Huds. Gunsight Pass and Lake.

Stenanthium occidentale Gray. Blackfoot Glacier and Gunsight Pass.

Zygadenus elegans var. **Coloradensis** (Rydberg Torr. Bull. 27 524 (1900) as species). Z. alpinus Blankenship. This intergrades freely with the type. Common mostly in alpine places, MacDougal peak and all through the Sperry Glacier region.

Zygadenus venenosus Wat. Frequent in all sorts of places and elevations. MacDougal and McDonald peaks, Wild Horse Island, St. Ignatius Mission, Yellow Bay, Polson, Bull Island, Bigfork, Evaro, Alta, Ronan, McDonald Lake in the Mission Mts. The segregates of Rydberg have no standing whatever.

Veratrum viride Ait. MacDougal and McDonald peaks, throughout the Sperry Glacier region, Upper Marias Pass, McDonald Lake, Mission Mts. This is the only Veratrum in the region though V. Californicum has been reported.

Allium Schoenoprasum var. **Sibiricum** (L.) Hartm. This hardly deserves varietal name as both forms grow together. Gunsight Pass and Lake, Belton, Upper Marias Pass.

Allium fibrosum Rydberg. Rydberg was right in separating this from *A. reticulatum.* Daphnia Lake, Lima.

Allium reticulatum Fraser. Common along the upper Missoula river.

Smilacina sessilifolia (Baker) Nutt. Bigfork, St. Ignatius Mission, Yellow Bay, MacDougal and McDonald peaks, Bull Island and Wild Horse Island, Alta, Upper Marias Pass, Sperry Glacier.

Smilacina stellata (L.) Desf. Bigfork, Alta.

Smilacina amplexicaulis Nutt., **Vagnera brachypetala** Rydberg. Common at Bigfork, Yellow Bay, Wild Horse Island, Bull Island, St. Ignatius Mission, Ravalli, Evaro, Alta, Gunsight Lake, Upper Marias Pass.

Disporum trachycarpum (Wat.) B. & H. Somers, Bigfork, Yellow Bay, throughout the Sperry Glacier region.

Disporum Oreganum (Wat.) B. & H. Somers, Bigfork, Yellow Bay, Ravalli, Evaro, McDonald Lake, Mission Mts.

Streptopus amplexifolius (L.) DC. St. Ignatius Mission, McDonald peak, Swan Lake, Missoula, Alta, Sperry Glacier, Gunsight Lake.

Habenaria leucostachys (Lindl.) Wat. Alta. Common in the Sperry Glacier region.

Habenaria obtusata (Pursh) Rich. Foot of MacDougal peak, Mrs. Clemens.

Serapias gigantea (Dougl.) A. A. Eaton, Epipactis gigantea, Dougl. Swan Lake at Bond's Cabin and Jeff's Cabin. First found by Miss Norton. The writer doubts the wisdom of referring this to the genus Serapias.

Spiranthes Romanzoffiana Cham., **Gyrostachys stricta** Rydberg. MacDougal peak, Bigfork, Yellow Bay, Wild Horse Island, Bull Island, McDonald peak, Gunsight Lake, Alta, Evaro.

Listera cordata (L.) R. Br., L. **nephrophylla Rydberg.** McDonald Lake, Mission Mts.

Listera convallarioides (Swartz) Torr. Bigfork, Swan Lake, MacDougal and McDonald peaks, Yellow Bay, from Lake McDonald to St. Mary's Lake in the Sperry Glacier region.

Salix Babylonica (L.) This grows in graveyards.

Salix cordata Muhl. Common at low elevations in all localities.

Salix Novae-Angliae And. Lima.

Salix Novae-Angliae Var. **pseudocordata And.** Alta, Lambert Valley, Blackfoot Glacier and Sperry Glacier.

Salix monticola Bebb. Evaro, Alta, Browning.

Salix Scouleriana Barratt. Common all around Flathead Lake nearly to the upper edge of the Upper Temperate life zone, Columbia Falls.

Salix glaucops var. **glabrescens And.** MacDougal peak.

Salix Tweedyi (Bebb) Jones. This is reported from Flathead Pass, (Upper Marias) by Blankenship, but diligent search there fails to reveal it though the following is common there.

Salix Barclayi And. Upper Marias Pass and Sperry to Blackfoot Glacier especially on the Atlantic slope. It is a curious fact that willows are relatively scarce on the Pacific slope but the moment we get on the other slope they form the chief mountain vegetation forming almost impenetrable thickets, even though the humidity is less than on the west.

Salix Barrattiana Hook Specimens gotten by Williams at Columbia Falls on the high peaks seem to belong here.

Salix chlorophylla And. Gunsight Lake.

Salix polaris Wahl. Sperry Glacier.

Salix reticulata L. **S. saximontana Rydberg.** This very variable willow abounds on MacDougal to McDonald peaks, also throughout the Sperry Glacier region, Monida, Lambert Valley. Ours are the var. nivalis mostly.

Salix Fernaldi Blankenship. Blankenship seems to be right in making a species of the western forms of S. vestita. It is characterized by the ovate pods being 2 to 3 mm long only, and the leaves not retuse but rounded at tip. The other characters given amount to nothing, particularly the pubescence and reticulation of the leaves. Young leaves sometimes show little reticulation but old ones are remarkable for it. This is frequent throughout the high peaks.

Salix desertorum Rich. Gunsight Pass.

Salix candida Fluegge. Rost Lake and Schultze's cabin.

Salix rostrata Rich. Common everywhere almost to the alpine.

Salix macrocarpa Nutt. Bigfork, Swan Lake, McDonald peak, Hot Springs, Monida, Lima.

Salix pellita And. MacDougal peak, Swan Lake, Blackfoot and Sperry Glaciers. Blankenship in his Supp. Fl. Mont. p. 46 says that S. bella Piper is a segregate from S. Sitchensis (namely is S. pellita), but this is an error, it is a form of S. glaucops with two stamens. Cusick has at last solved the relationship of S. pellita by finding that it always has one stamen and is therefore the inland representative of S. Sitchensis as suggested in my Willows p. 25.

Salix nigra has been reported from this region but all specimens so referred are **S. lasiandra.** The same is true of **S. amygdaloides.**

Salix lasiandra Benth. This is common around Flathead Lake, especially on the shores, also St. Ignatius Mission, Ronan, Alta, McDonald Lake in the Mission Mts. mostly the var. **lancifolia.**

Populus trichocarpa T. & G. This seems to be the only narrow-leaved cottonwood west of the Atlantic slope. All forms so far reported as **P. balsamifera** are this species. The only characters that seem to hold are the 3-valved pod and hairy surface, but even the latter apparently does not hold in all cases. The species abounds at low elevations everywhere.

Populus deltoides Marsh. Flathead Delta, Thompson's Falls, Bonner's Ferry, Idaho. Ours is the var. **occidentalis** with smaller leaves.

Betula glandulosa Mx. In the Torrey Bulletin for August, 1909, Mr. B. T. Butler, who was at Bigfork a few weeks in 1908 and a short time in 1909, creates several species from this and B. microphylla out of very small amount of material and from very little field study, amounting to descriptions drawn from single trees, none of which species are tenable. His segregates from B. glandulosa are B. glandulifera Butler, B. Elrodiana Butler, B. crenata Rydberg. To these might be added B. Hallii Howell. B. glandulosa varies in size and leaves according to exposure and moisture where it grows. It abounds at the cold lakes at low elevations and on up to the alpine meadows on all the mountains from Alta in the far south to the Sperry Glacier region.

Betula microphylla Bunge. The typical form of this grows in Deer Lodge valley. The common form is var. **occidentalis** (Hooker Fl. Am. 2 155 (1839) as species). This has again been the subject of much unnecessary dissection such as B. fontinalis Sargent, B. Sandbergii Britton, B. Utahensis Britton, B. Piperi Britton. It is characterized by the chestnut-colored bark till quite old, which does not peel up in thin flakes, the cambium layer not separating from the tree readily when cut, and by the tufted habit, growing in clumps from a single root. In Utah and the drier regions it rarely reaches 20 feet high and is very slender, but in the more moist places in Montana, especially along creeks it is often 30 or rarely 40 feet high and 6-8 inches through. I have seen a few trees a foot thick in deep woods where the bark peals up tardily and simulates forms of B. alba. It is almost never seen except along creeks and at springs. The shape of the bracts amounts to nothing. It is common in our region and east at least as far as Helena, and south to southern Utah.

Betula alba L. Mr. Butler takes up the paper birches and recognizes every name ever applied to them but one as distinct species almost, such as B. Alaskana Sargent, and B. papyrifera Mx. The paper birches are at once recognized by growing singly from the root and forming large trees, or at least are not tufted as in the other species. The cambium layer pops off as soon as cut through carrying the rest of the bark with it. It grows indifferently along creeks, lake shores and in dark woods in wet places.

The typical form has the bark flaking up in thin and papery white sheets even in young trees. It is very common throughout the region to St. Mary's Lake on the Atlantic slope east of Blackfoot Glacier.

Betula alba var. pendula (Roth Fl. Ger. 1 405 (1788) as species). Mr. Butler again dissects this and makes new names out of forms such as B. subcordata Rydberg, B. Montanensis Butler, and curiously refers B. occidentalis Hooker to it, when the typical form of it is described as low and shrubby. (See DC. Prod. 16 2). His B. Montanensis is founded on a single old and partly dead tree. This shades by imperceptible degrees into the type. It is characterized by the bark peeling off more tardily and in rather thick and cardboard-like layers. This also is common in our region. This is called B. occidentalis by Blankenship in his Supp. Fl. Mont. 48.

Alnus incana (L.) **Willd.** This is very common from Alta to the Sperry Glacier region along creeks and lake shores at low elevations. The var. virescens Watson has been reported from Flathead Lake but diligent search fails to reveal it though it is common east and south but out of our range.

Alnus crispa (Dryand) Pursh. This is the A. viridis and A. Alnabetula of most writers. It is rather common on mountain sides in subalpine places, going up to alpine meadows, from Alta to the Sperry Glacier region.

Oaks have been reported from our region but every case proves to be wrong so far.

Urtica gracilis Ait. Frequent in wet woods and along creeks under Willows from Alta to Gunsight Lake.

Urtica Breweri Wat. has been reported from our region but all specimens prove to be the above.

Arceuthobium Douglasii Eng. This grows on the red fir making the twigs spindle out and droop like the weeping willow, and in large tufts, it aborts whole limbs. The tufts are 4-6 feet wide and 2-3 feet thick. The parasite runs along under the bark and breaks out at the joints. It seems to bloom early in the spring, as next season's buds were forming in July. It is very common throughout our region but good fruit is seldom seen.

Arceuthobium Douglasii var. **Tsugensis** (Rosendahl Minn. Bot. Stud. 3 2 273 (1903) as Razoumofskya). This has not yet been found in our region but is to be expected on the hemlock.

Arceuthobium Douglasii var. **Laricis** (Piper Fl. Wash, 223 (1906) as Razoumofskya). This is also very common but is seldom seen in fruit. It acts in the same way as on the red fir as to aborting branches but the tufts are rigid and very knotty, and twigs are thickened, short and rigid and congested in small tufts 2-3 feet wide and a foot thick. The stems are thicker and longer on the parasite than in the type. McDonald Lake in the Mission Mts., Bigfork and Yellow Bay, both in flower and fruit, Aug. 12, 1908.

Arceuthobium Americanum Eng. Alta, on Pinus Murrayana.

Comandra umbellata var. **pallida** (DC.) Jones. Common on dry prairies and on dry mountain slopes from the Lower Missoula river to Browning.

Polygonum minimum Wat. McDonald peak and Mission Creek, also Sperry Glacier to Gunsight Pass and Lake, subalpine.

Polygonum Douglasii Greene. Common in dry and gravelly places from Alta north and east.

Polygonum polygaloides Meisner. Upper Marias Pass.

Polygonum bistortoides Pursh. Frequent on all the high peaks, also at Evaro and Mission Creek.

Polygonum viviparum L. Lambert Valley, Sperry Glacier to Gunsight Pass.

Polygonum Pennsylvanicum L. Bigfork, Echo Lake.

Polygonum Persicarioides HBK. Darby.

Polygonum ***Persicaria*** *L. St.* Ignatius Mission.

Polygonum punctatum *Ell.* Polson Swamp, St. Ignatius Mission.

Polygonum Hydropiper *L.* Polson Swamp.

Polygonum alpinum *All.* Como Peak.

Rumex pauciflorus Nutt. Monida, Evaro, Gunsight Pass.

Rumex occidentalis Wat. Swan Lake, Ronan, Alta, Browning.

Rumex crispus L. Common at low elevations from Alta northward.

Rumex salicifolius Weinm. Frequent along streams from Alta northward.

Rumex Persicarioides L. Frequent on the lake shores, also Hot Springs, Swan Like, St. Ignatius Mission, Whitefish, Browning.

Eriogonum multiceps Nees. Garrison and Monida.

Eriogonum ovalifolium Nutt. This is the alpine form E. nivale (Canby) Small. Common on all the high peaks.

Eriogonum ovalifolium var. **proliferum.** Wat. Alta.

Eriogonum umbellatum var. **stellatum** (Bth.) Jones. Alta.

Eriogonum umbellatum var. **subalpinum** (Greene) Jones. Alta, Gunsight Pass and Blackfoot Glacier, Summit.

Eriogonum flavum Nutt. Browning.

Eriogonum flavum var. **androsaceum** (Bth.) Jones. This should include E. Piperi Greene. Common on all the high peaks and very variable in the stipe.

Chenopodium hybridum L. Bigfork, Ravalli.

Chenopodium album L. Common from Polson to Bigfork and Browning.

Chenopodium glaucum L. Common on dry flats from the Hot Springs to Browning.

Chenopodium Botrys L. Ravalli.

Chenopodium rubrum L. Bigfork, Alta.

Atriplex truncata (Toor.) Gray. Common on the Little Bitter Root.

Atriplex Nuttallii Wat. Hot Springs and the Little Bitter Root.

Monolepis chenopodioides (Nutt.) Moq. Bigfork, St. Ignatius Mission, Dayton, Bull Island, Ronan, Alta.

Suaeda depressa (Pursh) Ledebour. Hot Springs and Polson.

Salsola Kali L. Common in waste places throughout at low elevations.

Amarantus graecizans L. Common in fields at low elevations.

Amarantus blitoides Wat. Ronan.

Amarantus retroflexus L. Common in fields at low elevations.

Oxybaphus angustifolius Sweet. Garrison.

Sagina Linnaei Presl. Lambert Valley, Sperry Glacier.

Arenaria tenella Nutt. MacDougal and McDonald Peaks, Lambert Valley, McDonald Lake Mission Mts., Sperry and Blackfoot Glaciers.

Arenaria verna var. **rubella** (Wahl.) Hook. MacDougal Peak.

Arenaria Nuttallii Pax. Lambert Valley.

Arenaria Sajanensis Willd. McDonald Peak, Elrod Peak (Elrod), Lambert Valley, Sperry and Blackfoot Glaciers.

Arenaria Fendleri Gray. Upper Marias Pass, Alta.

Arenaria aculeata Wat. Alta. This is probably only a form of A. congesta.

Arenaria congesta Nutt. Wild Horse Island, Alta.

Arenaria congesta var. **subcongesta** Wat. var. lithophila Rydberg. Alta, also reported from MacDougal Peak by Umbach.

Arenaria capillaris Poir. MacDougal Peak, Sperry to Blackfoot Glacier, also Elrod Peak (Elrod) and Swan Lake, MacDougal Peak (Miss Norton).

Arenaria capillaris var. **ursina** Rob. MacDougal and McDonald Peaks, also by Elrod.

Arenaria lateriflora L. Missoula and Swan Lake (Elrod).

Arenaria macrophylla Hook. Alta.

Stellaria calycantha Bong. McDonald Lake in the Mission Mts.

Stellaria borealis Bigelow. Alta, also var. **corallina.** Missoula (Elrod).

Stellaria umbellata Turcz. Sperry Glacier.

Stellaria longifolia Muhl. Alta. Missoula and Swan Lake (Elrod).

Stellaria longipes Goldie. Alta. Lolo (Elrod), Columbia Falls (Williams).

Stellaria longipes var. **Edwardsii** (R. Br.) Wat. Bigfork, Alta, Upper Marias Pass.

Stellaria longipes var. **laeta** (Rich.) Wat. Common in meadows at low elevations.

Stellaria nitens Nutt. Columbia Falls (Williams).

Cerastium nutans Raf. Alta.

Cerastium alpinum L. var. **Beeringhianum** Regel. Bigfork, MacDougal and McDonald Peaks, Yellow Bay, Dayton, Wild Horse and Bull Islands, Alta.

Cerastium alpinum var. **Fischerianum** T. & G. MacDougal and McDonald Peaks, Sperry to Blackfoot Glacier.

Cerastium arvense var. **Fuegianum** Hook. Sperry Glacier.

Cerastium arvense var. **oblongifolium** Hollick & Britton. Sperry Glacier, Mission Creek, Lake McDonald, Mission Mts.

Silene conubalus Wibel. Ravalli.

Silene Douglasii Hook. Common in the mountains at all elevations.

Silene Douglasii var. **viscida** Rob. MacDougal and McDonald Peaks, common.

Silene Douglasii var. **brachycalyx** Rob. Blackfoot Glacier.

Silene Scouleri Hook. Alta.

Lychnis Drummondii (Hook.) Wat. Browning.

Lychnis apetala L. Blackfoot Glacier.

Agrostemma Githago L. Bigfork.

Dianthus Armeria L. Ravalli. Perfectly established.

Portulaca oleracea L. Bigfork.

Lewisia pygmaea (Gray) Rob. Gunsight Pass, Sperry Glacier (Umbach).

Montia perfoliata (Donn) Howell. Evaro, Bigfork. The parviflora form Lambert Valley.

Montia parvifolia (Moc.) Greene. Lambert Valley, Sperry to Blackfoot Glacier.

Montia linearis (Dougl.) Greene. Alta, Ronan. Missoula (Elrod).

Claytonia megarrhiza (Gray) Parry. MacDougal Peak, Sperry Glacier.

Claytonia lanceolata Pursh. Lambert Valley, McDonald Lake in the Mission Mts., Missoula (Elrod).

Nymphaea polysepala (Eng.) Greene. Common in shallow lakes and near the shores of Flathead Lake from Alta northward.

Ranunculus multifidus Pursh var. **terrestris** Gray. Bigfork, Alta.

Ranunculus Purshii Rich. This is reported from our region but no valid specimens seen.

Ranunculus Flammula L. var. **intermedius**. Hook. Common on all the shores of Flathead Lake, also from Lake McDonald to St. Mary's Lake.

Ranunculus Pygmaeus Wahl. Sperry Glacier, Como Peak.

Ranunculus eximeus Greene. McDonald Lake Mission Mts. Not distinct from the following.

Ranunculus Eschscholtzii Schl. Lambert Valley, Como Peak, Blackfoot to Sperry Glacier, Elrod Peak (Elrod).

Ranunculus affinis R. Br. Bigfork (Miss Norton).

Ranunculus affinis var. **validus** Gray. The form of this with smooth seeds called R. alpeophilus Nelson is common on MacDougal Peak, McDonald Peak.

Ranunculus sceleratus L. R. **eremogenes** Greene. Common at low elevations, Ravalli to Upper Marias Pass.

Ranunculus Pennsylvanicus L. Polson Swamp, Bigfork, Whitefish.

Ranunculus Macounii Britton. Common on lake shores, Ravalli, Ronan, Flathead Lake, Swan Lake.

Ranunculus tenellus Nutt. Common on lake shores and in wet meadows from Alta northward.

Ranunculus tenellus var. **Lyallii** (Gray) Rob. Bigfork.

Ranunculus circinatus Sibth. Common, Flathead Lake, Ravalli, Ronan.

Ranunculus aquatilis L. Common at low elevations; the var. capillaceus at Bigfork; var. trichophyllus. Common, var. caespitosus at Bigfork; var. **heterophyllus** at Alta and Upper Marias Pass.

Ranunculus Cymbalaria Pursh. Darby, Browning, Upper Marias Pass, Missoula, Dayton, Hot Springs, St. Ignatius Mission.

Myosurus minimus L. Ronan.

Trautvetteria grandis Nutt. Alta.

Thalictrum sparsiflorum Turcz. Alta.

Thalictrum occidentale Gray. Common in open woods and mountain sides from Evaro northward. T. venulosum Trelease seems to be only a form of this.

Thalictrum purpurascens L. Ravalli, Ronan, Lolo. Gotten also at Plains by MacDougal.

Anemone parviflora Mx. MacDougal Peak, Lambert Valley, Blackfoot Glacier.

Anemone Drummondii Wat. Bt. Cal. 2 424 (1880). Drummond's Anemone. Elrod Peak (Elrod), and Mission Mts. (Elrod). Alpine. This little understood plant has alternately been referred to Tetonensis and allied species. A detailed description of it as it is may clear up some doubts. Flowers 35 mm. wide. Sepals fully 15 mm. long, oval, blue externally and white within, villous. Flowering peduncle 2.5-7.5 cm. long, 10 cm. long in fruit, stout, erect. Involucre with short and broad base, 7.5-15 cm. long, about like the leaves but large. Flowers single. Scape stout, almost none in flower, short in fruit. Plants caespitose from a thick root after the fashion of A. Hudsoniana. Leaves leathery, thrice ternate, with cuneate-oblanceolate lobes 9-13 mm. long and apiculate, nearly smooth. Styles filiform, 2.5 mm. long. Akenes long-woolly except in a narrow line on the back where it is short-hairy. Flowers about twice the size of A. Hudsoniana. Heads ovate 15 mm. long. Sperry Glacier, Lambert Valley, McDonald Lake, Mission Mts.

Anemone patens var. **Nuttalliana** (Spreng) Gray. Rexford, Garrison, Ravalli, Missoula (Elrod).

Anemone occidentalis Wat. Very common on MacDougal Peak and Blackfoot Glacier and Lambert Valley. Alpine.

Clematis hirsutissima Pursh C. Douglasii Hook. Evaro.

Clematis verticillaris var. **Columbiana** (Nutt.) Gray. Frequent from Alta to Blackfoot Glacier.

Coptis occidentalis (Nutt.) T. & G. Alta on rotten logs in deep shade.

Trollius laxus Salisb. Alta, McDonald Lake, Mission Mts., Sperry Glacier, abundant at Gunsight Pass and Lake.

Aquilegia flavescens Wat. Bot. King 10 (1871). Yellow Columbine. Common in open, wet and springy but well drained places and rarely on slopes, alpine and subalpine, even to the top of MacDougal Peak. Sometimes pink, but not differing otherwise. Piper, Fl. Wash, 279, states that this species freely intergrades with A. formosa. The writer has seen no such intergrades, but they are to be expected as this species, A. formosa, and A. truncata, ar manifestly recent offshoots of A. Canadensis, from which they hardly deserve separation. Robinson has also fallen into the error of Watson (Bot. King 10) in the Synoptical Flora, 43, where he speaks of the "alpine smaller flowered form" as regarded as distinct by me. Watson's smaller flowered form, as shown by his own specimens, was not alpine, but was got low down in City Creek Canon near Salt Lake City, and is a well defined species which I have many times collected in the type locality. Watson's reference to its being alpine is evidently an error which Robinson has copied. The plant described by Watson looks more like a hybrid between A. coerulea and the "small flowered form" in Utah, where Watson got it. It is always alpine. But identically the same thing grows throughout Wyoming, Idaho and Montana in places where A. coerulea is not found and therefore cannot be a hybrid. This species can be instantly separated from all forms of A. formosa that I have seen by the short and hooked spurs, but in the north country it is sometimes with red sepals. McDonald Peak, also Columbia Falls (Williams). MacDougal Peak (Elrod, MacDougal and Umbach). Hall's

Peak (Miss Norton). Sperry Glacier (Umbach). McDonald Lake, Alta, Common. Lake McDonald to St. Mary's Lake, mostly alpine. Missoula.

Aquilegia formosa Fischer, is reported from all over the state but all forms so far seen are the above with tinged petals or sepals.

Aquilegia saximontana Rydberg. Gunsight Pass. This is nearer A. vulgaris, with glandular stems and pubescent fruit.

Aquilegia Jonesii Parry. Gunsight Pass.

Actaea spicata var. **rubra** Ait. Hort. Kew 2 221. A rubra (Ait) Willd. This includes the var, arguta which cannot be separated by any valuable character. A. eburnea Rydberg. Berries when red are indifferently spherical to oblong in the same spike which is oblong in fruit. Occasional in deep forests and along creeks in wet and springy places. Huckleberry spring, Schultze's cabin, the bog on the road to MacDougal Peak, Yellow Bay at creek, the Hemlocks, McDonald Peak, Hot Springs. Middle Temperate life zine. A form answering to var, arguta with white berries grows with the other but differs in no other way. These berries are almost always round, not so large, spikes elongating in fruit, leaves usually more cleft. MacDougal Peak, in the Mission Mountains, Common from Lake McDonald to St. Mary's Lake, Summit.

Aconitum Columbianum Nutt. Libby (Bailey).

Aconitum Columbianum var. **lutescens.** (Nelson Bot. Gaz., 41 54 1906, as species). Flowers constantly cream-colored. Alta, Lambert Valley. Not seen in the Sperry Glacier region.

Delphinium pauciflorum Nutt. MacDougal Peak, McDonald Lake Mission Mts., Blackfoot Glacier. Alpine.

Papaver nudicaule L. 507. Ours is the var. **arcticum** Elkan Mon. Pap. 16 (1839). Stanton Lake, Williams. Alpine. The published description of this species is not good. Stems from a densely leaved and few branched crown, and this from a slender and branching root. Leaves all radical, 5 cm. long, with blade 15-25 mm. long, broadly ovate, pinnately lobed with oblong-obovate apiculate and veiny lobes 2-5mm. long, thick, tips all with yellow needles and some on the face. Peduncles erect from a decumbent or curved base, 10 cm. long, slender, with stiff and yellow needles (not dark). Pods obovate-oval, more densely setose as well as the elliptical sepals, pods 15 mm. long.

Corydalis aurea Willd. Alta, McDonald Lake in the Mission Mts., Bigfork, (also by Elrod and Miss Norton).

Draba alpina I. Sperry Glacier.

Draba glacialis Adams. Sperry Glacier, Gunsight Pass.

Draba nemorosa L. Evaro, Missoula (Elrod).

Draba stenoloba Ledebour. MacDougal Peak, Sperry Glacier.

Draba crassifolia Graham. MacDougal Peak, Blackfoot and Sperry Glacier.

Lesquerella alpina Wat. Garrison. Probably also at Alta.

Lepidium apetalum Willd. Fort Missoula, Ravalli, Ronan, Alta. Missoula (Elrod).

Lepidium medium Greene. Common in fields.

Thlaspi alpestre L. Alta. Material gathered at Missoula by Elrod corresponds well with Watson's T. Californicum except that the radical leaves are wider and the pedicels indifferently spreading.

Thlaspi arvense L. Alta.

Capsella Bursa-pastoris (L) Medic. Common around dwellings.

Camelina sativa (L.) Crantz. Bigfork, Ronan.

Brassica arvensis (L.) BSP. A frequent weed in fields throughout the region.

Sisymbrium incisum Eng. var. **Hartwegianum** B. & W. Garrison.

Sisymbrium incisum *var. filipes Gray.* Evaro, Alta.

Sisymbrium canescens *Nutt.* Missoula (Elrod and MacDougal); Polson *(Umbach).*

Sisymbrium officinale *(L.) Scop.* St. Ignatius Mission.

Sisymbrium altissimum L. A very common weed in fields throughout.

Erysimum cheiranthoides L. Ravalli, Evaro, McDonald Lake in the Mission Mts. Missoula (Elrod).

Erysimum asperum DC. Bigfork. Garrison.

Radicula Nasturtium (L.) Britten & Rendle. Common in springs throughout.

Radicula obtusa (Nutt.) Greene. Common at Bigfork, Ronan, Alta, Ravalli. This is hardly a good species.

Radicula curvisiliqua (Hook.) Greene. Bigfork.

Radicula palustris (L.) Moench. Bigfork, Dayton, Alta.

Barbarea vulgaris var. **stricta** (And) Gray. Missoula, Swan Lake, Evaro.

Dentaria macrocarpa Nutt. The leaves are remarkably thick and leathery. Stems spreading and much branched below. Roots white and elongated. It does not grow near water. Flowers very variable in size. McDonald Peak in talus, also crevices of rocks at Lambert Valley. Not seen in the Sperry Glacier region.

Cardamine Breweri Wat. I can see no difference between this and C. vallicola Nelson. Alta. Also at Missoula by Elrod, Columbia Falls by Williams, and Mission Mts. by MacDougal.

Cardamine oligosperma Nutt. Bull Island, Bigfork, Hot Springs, Alta.

Cardamine Pennsylvanica Muhl. Bigfork, Polson Swamp, Alta, Swan Lake (Elrod).

Cardamine parviflora L. Bigfork, Ravalli.

Arabis Nuttallii Rob. Lambert Valley, Mission Mts., Blackfoot Glacier.

Arabis glabra (L.) Bernh. Bigfork, Yellow Bay, MacDougal Peak, McDonald Lake in the Mission Mountains, Alta, Ravalli, Ronan, Lambert Valley, McDonald Lake.

Arabis Holboellii Hornem. Alta to the British Boundary.

Arabis Holboellii var. **patula** Wat. Upper Marias Pass. Swan Mountains (Elrod).

Arabis suffrutescens Greene. MacDougal Peak, Blackfoot Glacier.

Arabis Drummondii Gray. McDonald Lake in th Mission Mts., Sperry to Blackfoot Glacier.

Cleome serrulata Pursh. Bigfork, Hot Springs, Ravalli, Ronan. Missoula (Elrod).

Drosera rotundifolia L. Swan Lake. Rost Lake (Miss Norton).

ELROD'S STONECROP.

Sedum Elrodi n. sp. Closely related to S. divergens. Densely tufted from horizontal and fleshy rootstocks. Perennial. Leaves ovate, sessile, the lower 2-5 mm. long, the uppermost oblong-ovate, not over 5-12 mm. long, obtuse smooth. Stems erect from a sometimes decumbent base, closely covered with the nearly imbricated thick and closely appressed leaves, sparingly branched above, ending in 1-2 scorpioid racemes not over 2.5 cm. long and few flowered. Flowers yellow, nearly sessile. Petals lanceolate-acuminate, 7 mm. long, twice as long as the stamens and four times as long as the ovate and obtuse sepals. Follicles united below and divaricate above. At Somers on loose soil and also on rocks in open places. Middle Temperate life zone.

Sedum stenopetalum Pursh. MacDougal and McDonald Peaks, Sperry to Blackfoot Glacier. This is S. subalpinum Blenkinship, but his characters do not hold.

Sedum Douglasii var. **uniflora** (Howell Fl. 213 (1898) as species). Upper Marias Pass.

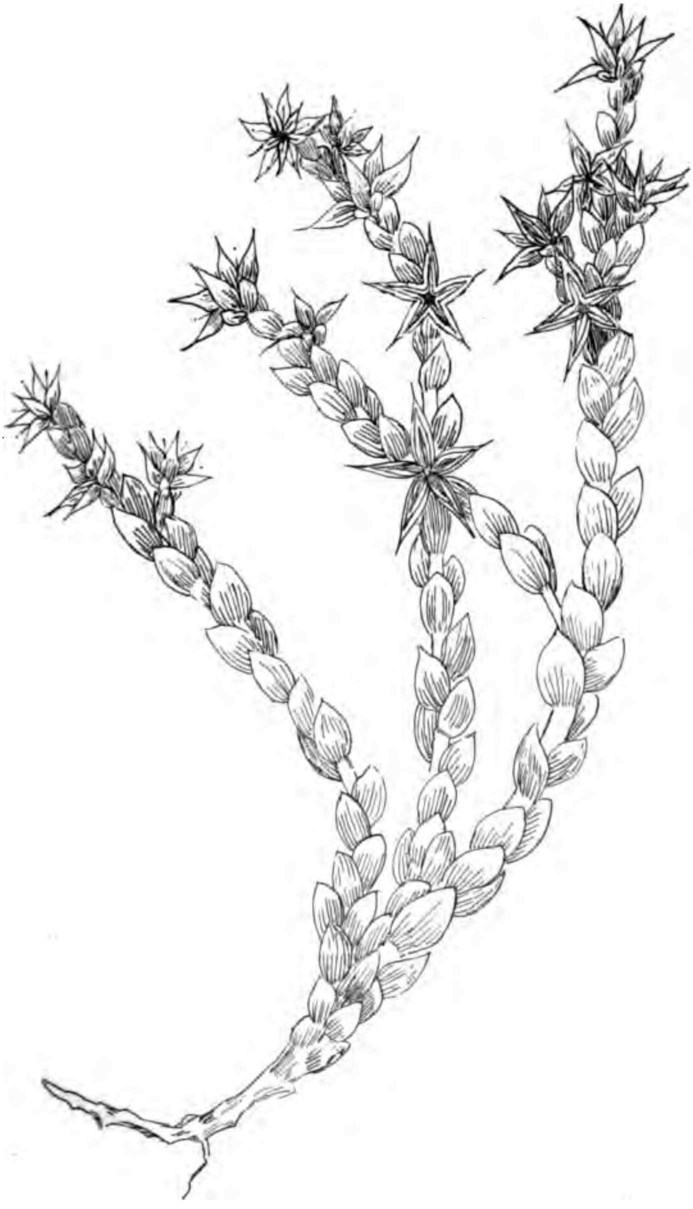
Sedum rhodanthum Gray. McDonald Peak, Sperry to Blackfoot Glacier, Lambert Valley, Upper Marias Pass. Mt. Lolo (Elrod).

Saxifraga oppositifolia L. Rare. Lambert Valley. Mission Mountains *(Elrod).*

Saxifraga adscendens L. MacDougal Peak.

Saxifraga chrysantha Gray. Mt. Lolo (Elrod).

PLATE IV.



SEDUM ELRODI JONES, N. S.

Saxifraga caespitosa L. Lambert Valley and Sperry Glacier.

Saxifraga rivularis L. Lambert Valley and Sperry Glacier, McDonald Lake in the Mission Mts.

Saxifraga debilis Eng. Reported from Sperry Glacier by Umbach, but may be the above.

Saxifraga cernua L. Lambert Valley.

Saxifraga Jamesii Torr. Mt. Lolo (Elrod). A very unexpected find. One would expect to find **S. heucheriforme** (Rydberg. Torr. Bull. 24 247 as Therofon) there instead.

Saxifraga arguta Don. MacDougal and McDonald Peaks, Yellow Bay, Alta. Common throughout the Mission and Swan Mountains at high elevations, and in the Sperry Glacier region. This is S. odontophylla Piper and S. punctata of recent authors. Piper is right in saying that the obovata-leaved S. punctata cannot be the same as this reniform leaved plant, but his name is preoccupied, and, in addition, S. arguta was well characterized by Hooker. It is easily separable from S. Nelsoniana by the clawed petals, as Piper has said, the latter being a Pacific Coast plant.

Saxifraga Mertensiana Bong. Darby at Como Peak, Sperry to Blackfoot Glacier.

Saxifraga stellaris L., S. Nutkana Moq., S. Bongardi Presl. There is a slight difference between this and S. stellaris, but that seems to be a very variable species. Common in the Sperry Glacier region. Leaves very variable.

Saxifraga reflexa Hook. McDonald Lake in the Mission Mountains, Sperry Glacier.

Saxifraga occidentalis Wat., Micranthes Alleni and aequidentata Small. Petals either entire or notched in the same flower, and either clavate or filiform also. MacDougal Peak, McDonald Lake in the Mission Mountains, Sperry to Blackfoot Glacier. Elrod Peak and Missoula (Elrod).

Saxifraga Oregana Howell., S. Sierrae Coville. This is the western representative of S. Pennsylvanica but with broader petals. The typical form has large and conspicuous petals, but they vary greatly down to S. Sierrae, and probably includes also S. Montanensis Small. It is a very robust plant. Mt. Haggin.

Saxifraga integrifolia Hook. This abounds in alpine places to the south of our region and adjoining it, but farther south passes by imperceptible degrees into

Saxifraga integrifolia var. **rhomboidea** (Green Pitt., 3. 343 as species). This is reported from Missoula and Deer Lodge. It grows at Lima. This again varies into

Saxifraga integrifolia var, **apetala** (Piper Torr. Bull. 27 393 as species).

Leptarrhena amplexifolia (Sternb.) Seringe. Sperry to Blackfoot Glacier. This grows in large patches from underground stems. Leaves waxy-green above and white below.

Boykinia major Gray. Hamilton.

Heuchera parvifolia var. **dissecta**. Leaves 5-7-lobed to or below the middle. Petals double the calyx lobes. Anaconda and Durant.

Heuchera cylindrica Dougl. Wheelock is certainly justified in putting all the variant forms into one species as there is a complete transition through all. This replaces S. rubescens on cliffs, which species abounds to the south in drier situations. The typical form with long red hairs on the petioles not yet found in our region.

Heuchera cylindrica var. **glabella** (T. & G.) Wheelock. Bull Island, Missoula, Bigfork, Coeur d'Alene Lake, Ravalli, Alta. Also gathered by all previous collectors.

Heuchera cylindrica var. **ovalifolia** (Nutt.) Wheelock. Lambert Valley *Upper Marias Pass*, Lake McDonald to St. Mary's in the Sperry Glacier *region. Alpine.*

Heuchera cylindrica var. **tenuifolia** Wheelock. MacDougal Peak.

Heuchera Hallii var. **grossulariifolia** (Rydberg Fl. Mont. 196 as species) Ryan's Lake and Mt. Haggin, both bordering on Deer Lodge Valley. Also at Ketchum, Idaho (Mrs. Brodhead).

Heuchera Williamsii Eaton. This both Greene and Rydberg put into Tellima (Lithophragma) because it has a turbinate calyx anu racemose habit, while they ignore the far more important heucheriod leaves, roots and five stamens, which clearly place it in Heuchera. Lima, probably not in our region.

Mitella trifida Graham. Bigfork, Alta, McDonald Lake in the Mission Mountains. Also Missoula by Elrod and MacDougal.

Mitella trifida var. **stauropetala** (Piper Erythea 7 161 as species.) Coeur d'Alene Lake, Deer Lake in Southern Idaho. Baker's number 263 from Mt. Hesperus, Colorado, is the same. This is a form with long and filiform lobes. Greene (Pitt. 1 32), Rydberg (Fl. Mont.), and Piper (Erythea 7), have split this species up into several unwarranted species, based on the development of lobes in the petals, but there is every gradation in length and width from rudimentary to long and filiform lobes. Greene's species is M. diversifolia, Rydberg's M. violacea, and Piper's M. stauropetala and stenopetala and var. Parryi.

Mitella Breweri Gray. Common on MacDougal Peak.

Mitella pentandra Hook. Common on all the high peaks from Alta northward.

Mitella nuda L. Frequent in dark woods from McDonald Lake in the Mission Mountains to the Boundary.

Tellima tenella (Nutt.) Walp. Missoula (Elrod); Columbia Falls (Williams).

Tellima glabra (Nutt.) Steud. Bigfork (Elrod); with short pedicels. Columbia Falls (Williams) with pedicels over half an inch long.

Tellima parviflora (Nutt.) Hook. Missoula (Elrod and MacDougal), Columbia Falls (Williams).

Tiarella trifoliata L. Bigfork, very rare. It was sought constantly throughout the region from Alta to Blackfoot Glacier this year but none could be found, while T. unifoliata was everywhere.

Parnassia parviflora DC. Swan Lake. All forms reported as P. palustris from this region are of this species. The Dissection of the staminodia amounts to but little.

Ribes Hudsonianum Rich., R. petiolare Douglas. There is no permanency in the characters of R. petiolare. Its leaves are normally much larger and longer petioled, but all sorts of intergrades occur, Alta, Hamilton, Anaconda and Mt. Haggin.

Ribes Howellii Greene. Its character of drooping short and few flowered racemes seems to hold, the others do not. St. Ignatius Mission in deep and dark willow swamps.

Ribes viscosissimum Pursh. Frequent in all the mountains from Alta northward.

Ribes cereum Dougl. Common in all the mountains from Alta northward.

Ribes lacustre (Pers.) Poir. Frequent at all elevations but most common at low elevations from Alta northward to the Boundary. The typical form has black fruit, slender racemes, and only lobed leaves.

Ribes lacustre var. **parvulum** Gray. This has leaves lobed nearly to the base and smooth, rarely over an inch wide, hardly deserves varietal rank. Hamilton, Anaconda, Alta.

Ribes lacustre var. **lentum** Jones, R. lacustre var. molle Gray. This is very pubescent and glutinous all over, with small and much dissected leaves often only half an inch wide. It is strikingly different from the type and grows in alpine places *only and usually* has red fruit, though not always. The *type and var. parvulum have black* fruit normally but often red when *immature. Alta, Como Peak.*

Ribes oxyacanthoides L. The typical form does not seem to grow in the west.

Ribes oxyanthoides var. **saxosum** (Lindl.) Colville, R. inerme Rydberg, R. vallicola Greene. This is the common smooth gooseberry of the streams, growing under willows at low elevations. Missoula. The form corresponding to R. imerme, with long peduncle, grows at Lima and St. Ignatius Mission. The ripe fruit is very palatable. Belton, Below Gunsight Lake, Mission Creek, Monida.

Ribes setosum Lindl. Anaconda, Ravalli, Alta, McDonald Lake in the Mission Mountains.

Ribes irriguum Dougl. Fruit sometimes with a few scattered prickles and sometimes white. Probably this and R. setosum are not distinct. . The plants that correspond to R. setosum are nearly smooth but with distinct cylindrical calyx, short peduncles, and sometimes is very setose, the species (R. setosum) is described as pubescent and very setose. What corresponds to R. irriguum has softly pubescent leaves and evident peduncles, and campanulate calyx. Bigfork, Yellow Bay, St. Ignatius Mission, MacDougal and McDonald Peaks, Bull Island, Dayton, Hot Springs, Missoula, Ravalli. Also Missoula (Elrod). I fail to see any good character to separate Green's R. cognatum or Blankinship's R. camporum.

Potentilla Monspeliensis L. Rexford and Whitfish, Ravalli, Upper Marias Pass. At the following places are the var. Norvegica, Bigfork, Daphnia Lake, Schultze's cabin.

Potentilla argentea L. Whitfish, apparently introduced.

Potentilla dissecta Pursh. MacDougal and McDonald Peaks, Lambert Valley, Sperry Glacier.

Potentilla dissecta var. **glaucophylla** (Lehm.) Wat. MacDougal Peak Same locality by Miss Norton and Umbach.

Potentilla decurrens (Wat.) Rydberg. Blackfoot Glacier.

Potentilla gracilis Dougl. Wild Horse Island.

Potentilla Blaschkeana Turcz. Alta, Ronan, Upper Marias Pass, Swan Lake by Elrod. A doubtful species.

Potentilla Nuttallii Lehm. Also a doubtful species. Alta, Monida. Missoula and St. Ignatius Mission (Elrod).

Potentilla ctenophora Rydberg. Monida, Missoula by Elrod.

Potentilla flabellifolia Hook. Ronan.

Potentilla Pennsylvanica L. Garrison and Lima.

Potentilla Hippiana Lehm. Browning.

Potentilla Anserina L. Frequent at low elevations throughout.

Potentilla pseudorupestris Rydberg. This probably includes convallaria. On all the high peaks from Alta northward. The convallaria form at Garrison.

Potentilla glutinosa Nutt. Alta to Bigfork on prairies and rocky Hillsides at low elevations. This may include P. Wrangeliana which was found at Alta.

Potentilla palustris (L.) Scop. Common in swamps at low elevations from Alta northward.

Geum ciliatum Pursh. Common in meadows at low elevations from Alta northward.

Geun rivale L. Bigfork, Below Gunsight Lake. Also Missoula (Elrod) and Rost Lake (MacDougal).

Geum strictum Soland. Ravalli.

Geum macrophyllum Willd. Common from Alta northward.

Purshia tridentata (Pursh) DC. Common on the western side of Flathead Lake, also on McDonald Peak.

Dryas Drummondii Rich. This seems to be rare. McDonald Peak and Blackfoot Glacier, alpine. The other species is very common.

Cercacarpus ledifolius Nutt. Alta. This has the habit of the var. intricatus but the leaves are nearer typical.

Fragaria bracteata Heller. Alta, McDonald Lake in the Mission Mountains.

Fragaria platypetala Rydberg. Bigfork, McDonald Lake in the Mission Mountains. Lake McDonald to St. Mary's Lake. The species of strawberry are in a state of confusion.

Rubus pedatus Smith. Bigfork. Rost Lake by MacDougal and Miss Norton. Columbia Falls by Williams.

Rubus parviflorus Nutt., R. Nutkanus Moq. Very common from Alta northward.

Rubus Idaeus var. **acutissimus** Reg. & Lndl. R. strigosus Mx. This variety has very hispid pedicels, short-petioled leaves, coarsely serrate and wide, fruit nearly double the size of the prevailing western plant. Ravalli, McDonald Lake in the Mission Mountains.

Rubus Idaeus var. **gracilipes.** Leaves long-petioled; leaflets mostly narrowly ovate, not coarsely serrate; pedicels nearly smooth, sepals barely tailed; fruit rarely over half an inch long; flowers small. Very common from Alta northward, and throughout the west. R. nivalis reported by Watson from the Bitter Root Valley is almost certainly a depauperate form of this species and not the true R. nivalis.

Sanguisorba annua Nutt. Common on the Flathead plains, Ravalli, Ronan, Evaro.

Rosa Nutkana Presl. St. Ignatius Mission, Browning.

Rosa Nutkana var. **MacDougali** (Holzinger Bot. Gaz. 21 36 as species). Alta, Mission Creek, common throughout the Flathead region.

Rosa pisocarpa Gray. Common in open and dry woods from Alta northward.

Prunus Americana Marsh. This has become established at Ravalli and in the Bitter Root valley.

Prunus emarginata (Dougl.) Walp. Common throughout the region from Mission Creek northward but not seen in the Sperry Glacier region though found at Belton and Upper Marias Pass.

Prunus mollis (Dougl.) Walp. Sand Point, Idaho. Libby (Bailey). Reported from Ravalli by MacDougal and Butler but diligent search fails to reveal it there. This is considered to be a variety of P. emarginata but I have seen no intergrades.

Prunus demissa (Nutt.)Dietr. I fail to see any ground for Nelson's P. melanocarpa, even though Nuttall describes his as red fruited, for we know that this species has fruit red till dead ripe when it turns black. Common everywhere at low elevations.

Spiraea Douglasii Hook. Alta, Sand Point, Idaho. Silloway Peak, MacDougal, Elrod Peak (Elrod), Lolo (Watson).

Spiraea Douglasii var. **Menzissii** (Hook.) Presl. Libby (Bailey).

Spirea densiflora Nutt. Bigfork, MacDougal Peak, Sperry Glacier to Gunsight Lake.

Spiraea corymbosa Raf. Common from Alta northward.

Physocarpa opulifolia var. **pauciflora** (T. & G.) Piper. Very common throughout.

Crataegus Douglasii Lindl., Bot. Reg. 21 to 1810 (1836). C. rivularis Nutt. Douglas's Hawthorne. Fruit red till near maturity. This can always be separated from the other species by the small spines, never branched, and by the narrow and less lobed leaves, and the open and less scraggy habit. It is much infested with a fungus, Roestelia. Very common along creeks and on the lake shores. Fruit more juicy than the red one. The bark is all smooth and gray except on large trunks below, where it flakes up some. It is a slender and opened branched shrub 15-30° high. Fruit blue-black, oval. Common *in all localities* except on the mountains, also at *Whitefish, Rexford and Sand Point,* Idaho. Missoula (MacDougal), and *Bigfork (Umbach), both as C. brevispina.* Middle Temperate life. Belton, *Ravalli, Ronan, McDonald Peak.*

Crataegus Columbiana Howell, Fl. 163 (1898). Columbian Hawthorne. This has gone under the name of C. occidentalis Britton and C. macracantha Lodd. as well as C. coccinea, and in all probability one name is as good as the other. There is no warrant whatever for the infinitessimal subdivision of Crataegus as is done by Sargent, Ashe, Britton, Rydberg and others. It can end only in making a species out of almost every sheet of specimens. Crataegus is remarkably sensitive to soil and drainage, like Amelanchier, and its leaves respond at once to varying conditions by their size and the amount of dissection of the margin as well as by the thickness. Another element of confusion lies in the fruit being red when immature in both species, turning black only at the last moment in C. Douglasii, and if specimens are taken by the grab sample way in which most are taken there is no reliance to be placed on the color. The only safe guide seems to be in the relation of the spines and leaves to each other. When the leaves are narrow and little dissected the spines are often slender. This is particularly true of the forms in the interior to which Greene has given the name salicifolia. The red fruited species in our region is common along creeks in the same situations as the other, and along the lake shore. When starved the leaves are small and the fruits few, but the bushes are very scraggly and thorny with generally branched thorns twice to four times as long as in the other species. Leaves normally much wider and more cut. The upper bark is smooth and gray, the lower bark rough in flakes. Fruit often as wide as long and sometimes yellow in trees growing side by side, and nearly always shorter and wider than in the other species. It is a pretty tree in the fall with its red fruit. Polson, Bigfork, St. Ignatius Mission, Wild Horse Island, Dayton, Hot Springs, where it is more abundant than the other. Wild Horse Island (Elrod), Rost Creek (MacDougal), Polson (Umbach, as C. occidentalis). Middle Temperate life zone. Some trees were completely covered by the red fungus Roestelia. No Crataegus in the Sperry Glacier region.

20. AMELANCHIER. SERVICE BERRY.

Amelanchier alnifolia Nutt. Gen. 1 306 (1818), and Jour. Phil. Acad. 7 22 (1834). This is the most sensitive to climatic differences of any species in the family. The humid regions have large and thin leaves with many teeth, long petals and racemose inflorescence, and fruit often half an inch wide. The most arid and hot regions have the leaves often not over half an inch long and nearly circular, and with few teeth, very thick and leathery, short petioles and raceme often reduced to a single pedicel, but in all this variance there is not a single permanent specific character. Our forms come near to those described as C. Cusickii Fernald with oval and subcordate leaves and long petals nearly an inch long. Fruit either one to few in a place or racemose, small or large, juicy or not. Common in dry places. Bigfork, Yellow Bay, on all the islands, Dayton, St. Ignatius Mission, McDonald Peak, Hot Springs. Elrod Peak (Elrod) and Wild Horse Island. Missoula (MacDougal and Elrod). Mission Creek, Lake McDonald to St. Mary's Lake, but not so common because of too much humidity, Ravalli, Ronan, Alta, McDonald Lake in the Mission Mountains.

Amelanchier alnifolia var. **Utahensis** (Koehne) Jones, is reported by both Piper and Rydberg from Washington and Montana but it does not grow in either state. Its habitat is on the edge of the Tropical life zone, under wholly different climatic conditions. The type of this variety is in my own herbarium collected by myself.

Pyrus Americana (Marsh) DC. Frequent from Alta northward.

Pyrus Sitchensis (Roem.) Piper. Blackfoot Glacier, Yellow Bay. There is doubt of the validity of this species.

Lupinus sericeus Pursh. Common in open pine woods from Alta northward.

Lupinus ornatus Dougl. Bigfork, Daphnia Lake, Wild Horse Island, Ravalli, Ronan. The var. bracteatus collected at Missoula by MacDougal and at Wild Horse Island by Elrod.

Lupinus alpicola Hend. Common in subalpine burns. MacDougal Peak, also at Belton and Evaro. Doubtfully distinct from L. sericeus.

Lupinus laxiflorus Dougl. Alta, Monida. Also Missoula and Bigfork (Elrod). No lupines seen in the Sperry Glacier region.

Trifolium hybridum L. Alta.

Trifolium pratense L. Bigfork, Polson, Alta, Ronan.

Trifolium longipes Nutt., T. Rydbergii Greene, T. latifolium Greene, T. caurinum Piper, are forms. Evaro, Alta, McDonald Lake in the Mission Mountains. No clovers seen in the Sperry Glacier region.

Medicago Lupulina L. Ravalli.

Glycyrrhiza lepidota Nutt. Frequent along lake shores and streams from Alta northward.

Astragalus decumbens (Nutt.) Gray. This grades into a multitude of forms, according to the shade and soil in which it grows. A. decumbens var. campestris (Gray) Jones is an extreme form, with wide leaves and ascending habit. Other synonyms are A. convallarius Greene, Homalobus hylophilus Rydberg, etc. Wild Horse Island, Rexford, Alta. MacDougal Peak (Miss Norton).

Astragalus pectinatus (Hook.) Douglas. Browning.

Astragalus leptaleus Gray. Big Arm, Monida, Somers. Wild Horse Island (Elrod), MacDougal Peak (Miss Norton).

Astragalus miser (Dougl.) Gray. Garrison, Upper Marias Pass.

Astragalus Bourgovii Gray. Common on all the peaks from Lambert Valley to the Blackfoot Glacier.

Astragalus alpinus L. Alta, Echo Lake. Reported from several other localities but probably confounded with A. Bourgovii.

Astragalus elegans Hook., A. eucosmus Rob. Supposed to grow at Upper Marias Pass, but probably confounded with A. Bourgovii.

Astragalus aboriginum var. **glabriusculus** (Gray.) Jones. Upper Marias Pass.

Astragalus Americanus (Hook.) Jones. Alta.

Astragalus Drummondii Dougl. Garrison, Missoula (MacDougal).

Astragalus agrestis Dougl. Evaro, Ronan, Missoula (MacDougal).

Astragalus nitidus Dougl. Browning.

Astragalus Canadensis var. **Mortoni** (Nutt.) Wat. Occasional from Alta northward in open woods and fields.

Astragalus Purshii Dougl. Missoula (Elrod).

Astragalus inflexus Dougl. Wild Horse Island, Missoula. Also at Missoula by Elrod and MacDougal.

Astragalus crassicarpus Nutt., A. prunifer Rydberg. Garrison and Browning.

Astragalus arrectus Gray., A. Kelseyi Rydberg. Deer Lodge Valley.

Astragalus flexuosus Dougl. Browning.

Oxytropis deflexa DC. Blackfoot G'acier, Mt. Hagin, Browning.

Oxytropis alpicola (Rydberg Fl. Mont, 252 as Aragallus). Blackfoot Glacier, Mt. Haggin.

Oxytropis monticola Gray. Deer Lodge Valley, Echo Lake, MacDougal Peak (Elrod and MacDougal).

Oxytropis Lamberti var. **ochroleuca** Nelson. There is no character that separates this from O. Lamberti but the color of the flowers. There is no character that separates it from O. monticola but the appressed calyx hairs. Normally the flowers are an inch long and the pod a trifle stiffer than in O. monticola, and less inflated, but these characters vary greatly. No specimens of this variety have as yet been reported from our drainage but it is common eastward and southward. The low and single stemmed plant of the plains seems abundantly distinct but unfortunately it passes by imperceptible gradations into the tufted froms with purple flower and exactly like this variety except the color of the flowers.

Oxytropis gracilis (Nelson Erythea 7 60 as Aragallus). Upper Marias Pass.

Oxytropis nana Nutt. Garrison.

Oxytropis splendens Dougl. Upper Marias Pass, Browning.

Oxytropis viscida Nutt. in T. & G. Fl. 1 341 (1850), Aragallus viscidus (Nutt.) Greene, Aragallus viscidulus Rydberg. Viscid Oxytropis. Rydberg's attempt to elucidate this species in the Flora of Montana has only added to the confusion, while his additional species has no foundation. He refers Nuttall's type to Oregon when it must have been collected either in Montana or Idaho. Nuttall gives it as on the "Headwaters of the Oregon," but the "Oregon" does not head in Oregon. Rydberg gives it as growing at 4000 to 8000 feet on hills when it is seldom found lower than 9000 feet, and then on rocky ridges in subalpine places. Watson's locality was 10,000 feet elevation. In his A. viscidulus Rydberg gives the habitat as dry hills and mountain sides when it is always high alpine or subalpine, from timberline (11,500 feet altitude in Utah) to 10,000 feet altitude on rocky ridges. His characterization of both species is equally erroneous. He says O. viscida always has yellow hairs at base of stems, when they are nearly always white as in the other. He says the hairs on stem, calyx and pods are white and never black in O. viscida while they are both, or in some cases wholly absent. One can always find black hairs underneath the shaggy white ones in O. viscida, as the shaggy ones get less the black ones become more evident. In O. viscidula the pubescence varies likewise, but the black hairs ar more evident and the shaggy ones only occasionally in evidence. In my specimens from Mt. Haggin in Deer Lodge Valley near timber line there is no pubescence on the calyx at all except the always present stipitate yellow glands which are very abundant, the specimens are depauperate and the old pods broadly oblong and obliquely short-apiculate, and about 1 cm. long. In my material from Ryan's Lake, same valley, near timber line the calyx is shaggy with white and black hairs intermixed. In my material from Lima, doubtless the same locality where Rydberg got his, the calyx is loosely shaggy with black hairs as well as the pods, and in specimens got close by the calyx is shaggy with white hairs, with a few black ones underneath. The pods vary from oblong-ovate and short-acuminate to lanceolate-acuminate, and from long-beaked to apiculate in pods from the same tuft, and from a half inch long to an inch long, with divergent beak. It is evident that Nuttall's original was a depauperate plant with slightly developed pods. In all my material, of which I have much, my field notes say the flowers are bright red, in drying they turn to blue, or when not quickly dried turn white, and this is probably the reason why Nuttall's specimens seem white flowered. This should grow on all our high peaks. Rydberg refers Watson's material from the East Humboldt Mts. Nevada, to O. viscida and mine from the Wasatch to O. viscidula, while they are the same, as I have material from both localities. This plant also grows at Browning on gravelly knolls.

Hedysarum boreale Nutt., H. Americanum (Mx.) Britt., H. lancifolium Rydberg. Common on the high peaks from Como Peak to Upper Marias Pass.

Hedysarum sulphurescens Rydberg. Common on the high peaks from McDonald Peak north and east.

Linum Lewisii Pursh. Frequent on prairies and in open woods throughout.

Geranium incisum Nutt. Common from Alta northward.

Geranium Carolinianum L. Frequent in fields and waste places. Bigfork, St. Ignatius Mission, Whitefish, Ravalli.

Geranium Carolinianum var. **longipes** Wat., G. Bicknellii Britton. This grows with the type. Ravalli, Alta, Bigfork.

Erodium cicutarium L'Her. Missoula (MacDougal).

Euphorbia glytosperma Eng. St. Ignatius Mission, Ravalli, Belton, Columbia Falls.

Euphorbia dictyosperma F. & M. Ravalli.

Callitriche palustris L. Bigfork, Ravalli, Alta, Darby, Browning.

Callitriche autumnalis L. Ronan, Evaro.

Rhus glabra L. Ravalli.

Rhus Toxicodendron L., R. Rydbergii Small. Frequent among rocks in all localities at low elevations.

Impatiens biflora Walt. Common in swamps at St. Ignatius Mission, Hot Springs, Ravalli, Sand Point (Idaho) and Bigfork, where it is in the latter place wholly cleistogamous.

Impatiens biflora var. **ecalcarata** Blankinship (Mont. Ag. Coll. Stud. 1 85 as species). This is simply a spurless form and grows along with the type. Also Swan Lake (Miss Norton).

Rhamnus Purshiana DC. Bigfork, Ravalli.

Ceanothus velutinus Dougl. MacDougal and McDonald Peaks, Upper Marias Pass.

Glossopetalon spinescens Gray. Alta.

Ampelopsis quinquefolia (L.) Mx., Parthenocissus—(L.) Planch, etc. Swan Lake, introduced.

Malvastrum coccineum (Pursh) Gray. Bitter Root and Deer Lodge Valleys, Browning.

Malva rotundifolia L. St. Ignatius Mission.

Sidalcea Oregana Gray. Ronan.

Hypericum Canadense var. **boreale** Britton. Polson Swamp, Bigfork.

Hypericum formosum HBK. Common from Ravalli to Blackfoot Glacier and St. Mary's Lake.

Hypericum Nortonae, n. sp. Miss Norton's St. John's Wort. Stems about 10 cm. long, erect from slender underground rootstocks, barely angled, simple. Leaves rather congested, nearly round to oval-ovate, obtuse, thick and scarcely at all black-punctate 1.5-2.2 cm. long, cordate, sessile, not clasping. Flowers 1-3, terminal, on a short, 2-bracted pedicels. Sepals ovate, obtuse, about 2.5 mm. long, greenish with purplish tips. Petals rather narrow strongly-many-nerved, yellow, 1-1.5 cm. long. Stamens many. Styles 3, long, distinct. Pods ovate, 3-lobed at tip. It is evidently allied to H. formosum. Alpine in moist places. McDonald Peak, Elrod Peak (Elrod). Dedicated to Miss Gertrude Norton, who has worked long on the flora of this region. Upper Marias Pass, Sperry Glacier, Lambert Valley. It shows no variation toward H. formosum.

Elatine Americana Arn. Common throughout the Flathead Valley.

Elatine brachysperma Gray. Alta.

Viola nephrophylla Greene. Bigfork, Swan Lake, Polson, Rost Lake, Wild Horse Island. Common.

Viola Canadensis L. Bigfork, Swan Lake, Rost Lake, McDonald Lake in the Mission Mountains, Blackfoot Glacier. Also gathered by all previous collectors.

Viola glabella Nutt. MacDougal Peak, Bigfork, Wild Horse Island.

Viola venosa (Wat.) Piper. Bigfork (Elrod).

Viola sarmentosa Dougl. McDonald Peak and Lake.

Viola sarmentosa var. orbiculata (Geyer) Gray. Bigfork, Yellow Bay, Belton.

Mentzelia laevicaulis (Dougl.) T. & G. Garrison.

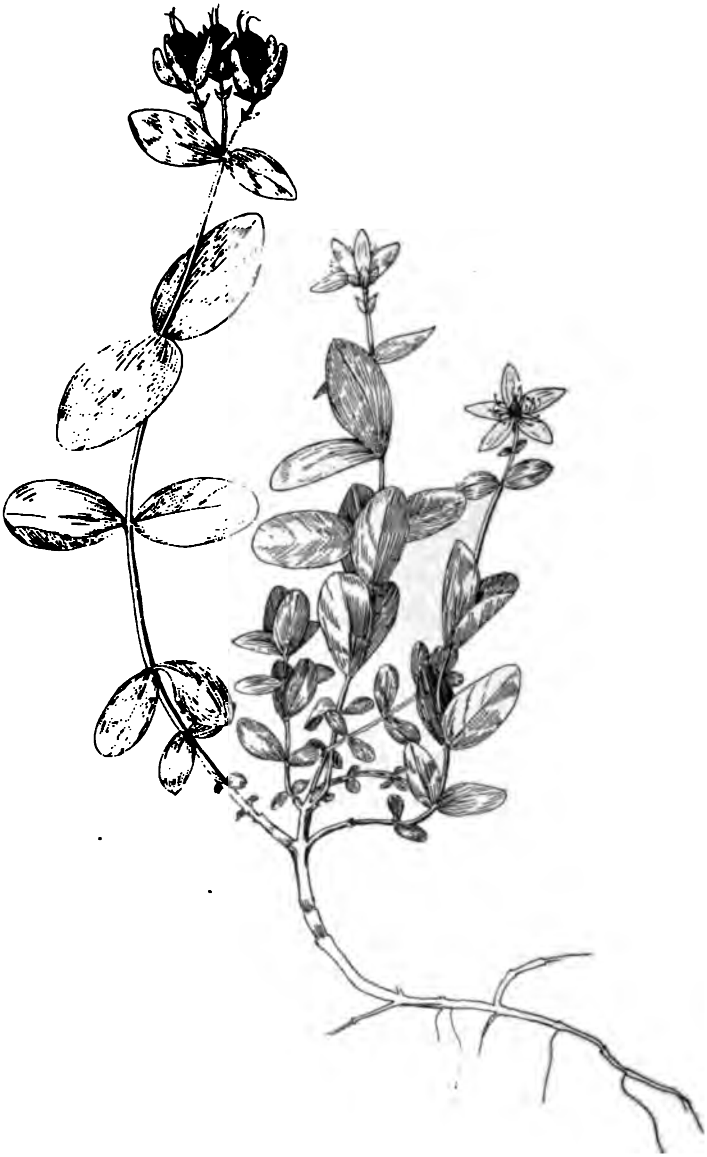
Opuntia polyacantha Haw. Garrison, Browning.

Circaea alpina L. Common in damp and deep woods from the Mission Mountains northward.

Circaea alpina var. ***Pacifica*** (Asch. & Mag. Bot. Zeit. 29 392 as species). This has deeper toothed leaves and normally minute bracts on the racemes but there are all sorts of intergrades. Yellow Bay.

Gaura coccinea Pursh. Ravalli, Browning.

PLATE V.



HYPERICUM NORTONAE JONES, N. S.

Oenothera biennis L. Polson, Ravalli, Browning.

Gayophytum caesium (Nutt.) T. & G. Alta.

Gayophytum ramosissimum (Nutt.) T. & G. Alta, Garrison.

Gayophytum diffusum (Nutt.) T. & G. Hot Springs.

Gayophytum lasiospermum Greene. Darby.

Epilobium augustifolium L. Common from Alta northward.

Epilobium latifolium L. MacDougal Peak, Gunsight Pass, Blackfoot Glacier, Upper Marias Pass.

Epilobium minutum Lindl. Mission Creek.

Epilobium palustre L. Polson Swamp.

Epilobium adenocaulon Hausskn. Common from Alta northward at low elevations.

Epilobium alpinum L. MacDougal and McDonald Peaks, Upper Marias Pass.

Epilobium Hornemanni Reich. This is a very doubtful species as it seems to intergrade with E. alpinum. Common on all the high peaks from Alta northward.

Epilobium clavatum Trelease. A very doubtful species. MacDougal Peak (Elrod and Umbach).

Epilobium glandulosum Lehm. Swan Lake.

Hippuris vulgaris L. Common in swamps throughout.

Myriophyllum spicatum L. Dayton, Bigfork.

Myriophyllum hippuroides Nutt. Common at Bigfork.

Myriophyllum verticillatum L. Common on the shores of Flathead Lake, Swan Lake, Daphina and Rost Lakes, Dayton, Whitefish.

Cogswellia macrocarpa (Nutt.) Jones. Common on dry prairies from Missoula northward.

Cogswellia simplex (Nutt. Bot. King 129 as Peucedanum). Common from Alta northward.

Cogswellia Altensis, n. sp. Allied to C. simplex. Stems several from a fleshy, elongated, not tuberous root, dark-green, 7-15 cm. long, erect. Whole plant smooth. Leaves biternate, with short root petioles and vaginate stem ones. Leaflets nearly filiform, falcate, acute, 5-8 cm. long, entire. Peduncles slender, about 1.5 dm. long. Rays very unequal, from 1.5-5 cm. long, slender, 3-6. Involucels of few needle-like bracts. Pedicels 2.5-7.5 mn. long, slender. Fruit about 7 mm. wide and 12 mm. long, oblong-obovate, the wings as wide as the body. Oil tubes solitary and large. Ribs evident and raised. Oil tubes on commissure threadlike, one on each side of the midnerve, and with another running down half way outside of it. Seed nearly flat and with linear cross section. Wings thickest at inner edge where they are about half as thick as the body of the seed. Alta, under pines on the upper edge of the Middle Temperate life zone, on dry south slopes.

Cogswellia Sandbergii (C. & R.) Jones. Subalpine on MacDougal Peak, also at Lake Louise near Sperry Glacier. This cannot be located in Coulter and Rose's Monograph because it is placed under "glabrous throughout" in the key, while the fruit is puberulent.

Cogswellia ambigua (Nutt.) Jones. Mission Creek.

Cogswellia montana (C. & R.) Jones. Missoula (Elrod).

Angelica Roseana Hend. Mission Creek and McDonald Peak.

Leptotaenia multifida Nutt. Common in all the mountains to the alpine.

Peptotaenia multifida var. Eatoni (C. & R.) Jones. MacDougal Peak, Alta. This includes L. filicina Jones probably.

Heraclueum lanatum Mx. Common from Alta northward.

Ligusticum tenuifolium C. & R. Alta.

Ligusticum Leibergi C. & R. Alta.

Cymopterus Elrodi n. sp. Habit of C. thapsoides. Shortly caulescent and densely branched from a woody root. Stems ascending, stout, 5-10 cm. long. Peduncles 3 dm. long. Leaves with stout petioles longer than the blades, blades ovate to deltoid in outline, ternately and then pinnately decompound, 1 dm. long, with filiform and aculeate and rigid but smooth segments about 2.5 mm. long. Rays about 10, unequal, 1.5-5 cm. long, stout. Slender pedicels about 10 cm. long. Bractlets needle-like and short. Fruit about 9 mm. long and half as wide, elliptical, truncate at tip and slightly emarginate at base. Lateral wings not over .6 mm. wide, dorsal reduced to raised ribs and with one or two of them slightly winged. Oil tubes about 5 in the intervals and 14 on the commissure. Seed face concave. This is nearest to C. thapsoides but the seed is twice as long and with mostly abortive wings. Alta, Mont. In the canyon of the Bitter Root River among loose rocks and gravel on dry knolls. July 11, 1909.

Musenium Hookeri Nutt. Garrison.

Bupleurum Americanum C. & R. Browning on the plains. Blankinship's B. purpureum is only an alpine form. Mt. Haggin and Lima.

Zizia cordata (Walt.) Koch. Browning.

Carum Gairdneri (H. & A.) Gray. Common from Alta northward.

Cicuta bulifera L.Swan Lake in swamp on decaying logs. Lake McDonald (Williams and Umbach).

Cicuta Douglasii (DC.) C. & R., C. vagans Greene. Browning, Ravalli.

Cicuta Douglassi var. **occidentalis** (Greene Pitt. 2 7 as species). This is the common form of the Great Plateau, with oval to elliptical fruit about 3 mm. long. Coulter and Rose say of this group "fruit oblong" while none of them are narrower than oval or elliptical, their own figure on p. 94 being oval or elliptical. In my specimens No. 1909 from Salt Lake City referred here by them the fruit is from depressed-orbicular to orbicular-ovate, and runs about 2 mm. long. They also say of the vagans group "fruit orbicular, oil tubes very narrow" while in fact they are very broad as often as narrow. St. Ignatius Mission.

Berula erecta (Huds.) Coville. Common all around Flathead Lake, Ronan, St. Ignatius Mission.

Sium cicutaefolium Gmel. Common in shallow water in all localities.

Osmorhiza divaricata Nutt. Coulter and Rose in their last monograph attempt to split up the species of this genus on the constriction of the tip of the fruit. An extensive examination of material shows that this is fallacious and their species invalid. This species includes Washingtonia Leibergi and brevipes. Leibergi forms are from MacDougal Peak and Blackfoot Glacier in the collection under consideration. Other forms are from the East Humboldt Mountains, Nevada, and Diamond Peak, Calif. My divaricata forms are from Ravalli and Bigfork, my brevipes forms from Bigfork and MacDougal Peak along with the others and growing under the same conditions.

Osmorhiza divaricata var. **nuda** (Torr. Pac. R. R. Rep. 4 93 as species). Washingtonia nuda and obtusa. Alta and MacDougal Peak. The Alta specimens have the leaflets of brevipes, but more acute, pedicels and peduncles very divaricate, fruit clavate, the body 10 mm. long, triangular-acute, beak .5-2.5 mm. long, stylopodium mostly wider than high and minute, pedicels longer than the fruit, leaflets 3-4 cm. long. Nelson's No. 4997 from Wallace Creek, Wyo., has the fruit peduncles and pedicels the same but fruit narrower and beak .5 mm. long and leaflets often 5.5 cm. long. My specimens from Payette Lake, Idaho, July 24, 1899, referred by Coulter and Rose to brevipes, are exactly obtusa in every particular, with the minute stylopodium and triangular-acute beakless tip, it also has the divaricate peduncles and pedicels. My No. 5580 from Provo, Utah, referred by them to this species is too immature to tell what it is, but some of the fruit is constructed below the tip like Leibergi, and with the minute depressed stylopodium. My No. 5893t from Marysvale, Utah, is not referred anywhere by them but is typical obtusa. O. nuda is readily recognized in California by the small leaves, broad leaflets and slender habit with elongated internodes and peduncles, but this form has both beaked and beakless fruit; when the beak is produced it is referred to brevipes by Coulter and Rose. The fruit is short and with short tails, pedicels longer than the fruit, plants mostly pubescent. This is represented in the interior more by the form obtusa, with smooth foliage somewhat larger and more pointed and narrower leaflets. All the species of Osmorhiza have the two forms of leaves, broad and deeply serrate or lobed leaflets, and lanceolate and less lobed and shallow serrate leaflets, which occur indifferently with the varying fruit characters. In the shade the leaflets are larger and more pubescent, in the sun they are much reduced, thicker and nearly smooth. Typical O. divaricata is characterized by the nearly linear beaked fruit with tail from nearly equal to half the body, pedicels nearly as long as the fruit (the central one often 1-2 inches long), large and acuminate leaflets, stylopodium longer than wide, plants nearly smooth.

Sanicula Marilandica L. Common from Evaro and Mission Creek to Sperry Glacier and Gunsight Lake.

Cornus Baileyi Evans. Is reported from our region, but the characters do not hold.

Pyrola minor L. Blackfoot Glacier.

Pyrola secunda L. Frequent from Alta northward.

Pyrola aphylla Smith. Yellow Bay and MacDougal Peak.

Pyrola chlorantha Swz. Yellow Bay and Bigfork.

Pyrola picta Smith. Como Peak.

Pyrola rotundifolia L. Common, Alta to Sperry Glacier.

Pyrola rotundifolia var. **bracteata** (Hook.) Gray. Belton, Gunsight Lake.

Pyrola rotundifolia var. **uliginosa** (Torr.) Gray. From MacDonald Lake in the Mission Mountains northward by Umbach, Miss Norton, MacDougal and Vreeland.

Pyrola rotundifolia var. **incarnata** DC. Mission Creek to St. Mary's Lake in the Sperry Glacier region.

Kalmia glauca var. **microphylla** Hook. MacDougal Peak. Common on all the peaks of the Sperry Glacier region.

Phyllodoce empetriformis (Smith) D. Don. Como Peak, common on all the peaks of the Sperry Glacier region, also Mission Creek. P. intermedia (Hook.) Rydberg.

Phyllodoce glanduliflorus (Hook.) Coville. Como Peak, Mission Creek. Common on all the peaks of the Sperry Glacier region. P. hybrida Rydberg.

Ledum glandulosum Nutt. Como Peak, Mission Creek, Alta, Belton.

Rhododendron albiflorum Hook. McDonald Peak and Mission Creek, Como Peak. This answers almost exactly to Cladothamnus.

Arctostaphylos Uva-ursi (L.) Spreng. Common everywhere on the mountains.

Vaccinium membranaceum Dougl., V. globulare Rydberg. Common at middle elevations from Alta northward.

Vaccinium caespitosum Mx. Upper Marias Pass.

Vaccinium myrtilloides var. **microphyllum** Hook. Common from Alta northward.

Vaccinium Canadense Kalm. Belton, Alta.

Centunculus minimus L. Ronan.

Douglasia montana Gray. Garrison. Missoula (Elrod).

Androsace septentrionalis L. Upper Marias Pass, Sperry to Blackfoot Glacier.

Androsace filiformis Retz. Alta.

Primula Parryi Gray. Como Peak.

Dodecatheon pauciflorum (Durand) Greene. Common from Alta northward.

Dodecatheon Meadia var. **lancifolium** Gray. Alta.

Dodecatheon Meadia var. **alpinum** Gray. Upper Marias Pass.

Frasera speciosa Dougl. Bitter Root Mountains.

Frasera albicaulis *Griseb. Alta.*

Gentiana Amarella *L. Common from* Alta northward.

Gentiana glauca *Pall. Sperry Glacier.* Also by Umbach.

Gentiana affinis Griseb. Polson Swamp, Big Arm.

Apocynum androsaemifolium L. Darby to Upper Marias Pass.

Apocynum cannabinum L. Yellow Bay, Dayton, Polson, Ravalli.

Convolvulus arvensis L. Bigfork, Belton, St. Ignatius Mission.

Phlox Douglasii Hook. Como Peak, Lambert Valley. Missoula (Elrod).

Gilia debilis Wat. McDonold Peak (Elrod).

Gilia aggregata (Pursh) Spreng. Alta, Mission Creek. Missoula (Elrod).

Gilia linearis (Nutt.) Gray. Common from Alta to Lake McDonald.

Gilia gracilis (Dougl.) Hook. Ravalli, Jocko Creek, MacDougal.

Gilia minutiflora Bth. Alta.

Gilia pharnaceoides Bth. Alta to Upper Marias Pass.

Polemonium mioranthum Bth. Hot Springs.

Polemonium coeruleum L. Alta.

Polemonium humile R. & S. Alta to Blackfoot Glacier.

Polemonium humile var. **pulchellum** (Bunge) Gray. MacDougal Peak and .Mission Creek.

Polemonium confertum Gray. Gunsight Peak.

Phacelia Franklinii Gray. Alta, Evaro.

Phacelia heterophylla Pursh. Alta to Sperry Glacier region.

Nemophila breviflora Gray. Garrison.

Hydrophyllum capitatum Dougl. Bigfork, McDonald Lake in the Mission Mountains.

Lithospermum ruderale Dougl., L. lanceolatum Rydberg. Common, Alta to Upper Marias Pass.

Lithospermum arvense L. Bigfork.

Mertensia oblongifolia G. Don. Mission Creek, Upper Marias Pass. Columbia Falls (Williams), Missoula (MacDougal and Elrod).

Lappula Redowskii (Hornem.) Greene. Common Alta to Bigfork.

Lappula Redowskii var. **cupulata** (Gray Bot. Cal. 1 530 as Echinospermum Red. var.). This grows with the other and grades into it.

Lappula floribunda (Lehm.) Greene. Alta and northward.

Krynitzkia canescens Gray. Upper Marias Pass and Browning.

Krynitzkia Californica Gray. Alta, Evaro, Browning.

Krynitzkia Watsoni Gray. Darby.

Krynitzkia affinis Gray. Evaro, Alta.

Krynitzkia crassi Gray. Garrison.

Krynitzkia crassisepala Gray. Garrison.

Verbena bracteosa Mx. Ravalli to Browning.

Verbena stricta Vent. Hot Springs.

Monarda fistulosa L. Common. Evaro to Belton.

Lycopus uniflorus Mx. Rost Lake, Swan Lake, Schultze's cabin.

Lycopus Virginicus L. Bigfork and Swan Lake.

Lycopus Americanus Muhl. Bigfork, Jordan Lakes, Hot Springs.

Mentha arvensis var. **Canadensis** (L.) Briquet., M. rubella Rydberg. Bigfork, Missoula (Elrod).

Mentha arvensis var. **glabrata** (Bth.) Fernald. Common all around Flathead Lake, Swan Lake, Hot Springs, St. Ignatius Mission.

Stachys palustris L. Common, Evaro and Ravalli to Whitfish and Rexford.

Physostegia parviflora Gray. Common all around Flathead Lake, Missoula (Elrod).

Prunella vulgaris L. Alta and northward.

Agastache urticifolia (Bth.) Rydberg. Evaro. Missoula (Elrod).

Nepeta Cataria L. Bigfork, Mission Creek.

Dracocephalum parviflorum Nutt. Ravalli, Evaro, Alta. Jocko Creek *(MacDougal).*

Scutellaria galericulata L. Common in swamps at Bigfork, Hot Springs, *Swan Lake,* Evaro, and around Flathead Lake.

Solanum triflorum Nutt. Evaro.

Physalis pubescens L. Bigfork.

Pedicularis bracteosa var. **Montanensis** (Rydberg Torr. Bull. 24 293 as species). This does not differ in anything but the purple flowers. The low altitude forms have spikes a foot long. Lambert Valley, Mission Creek, McDonald Lake, Bigfork, MacDougal Peak and Lake McDonald to St. Mary's.

Pedicularus Canbyi Gray, was again found on McDonald Peak. Also got on Silloway Peak by MacDougal.

Pedicularis Groenlandica Retz., Elephantella Rydberg. Frequent in the high mountains from Alta northward. All the other species of Pedicularis reported from this region were found.

Orthocarpus luteus Nutt. Upper Marias Pass, Bull and Wild Horse Islands.

Castilleia miniata Dougl. It is very variable in the pubescence and length of galea, very common from Alta northward.

Castilleia angustifolia (Nutt.) G. Don. Bigfork.

Castilleia pallida HBK. This is a very doubtful species. Common from Evaro and Ravalli northward.

Castilleia pallida var. **lutescens** Greenman. Wild Horse Island, Bigfork, Upper Marias. Pass, MacDougal Peak (Miss Norton).

Castilleia parviflora. This has been reported from various parts of our region, but all seem to be forms of angustifolia or miniata. I can make nothing out of the species proposed by Rydberg.

Castilleia pallescens (Gray) Greenman. Ravalli, Ronan, Evaro, Missoula (MacDougal).

Veronica Americana Schw. Common from Alta northward.

Veronica alpina L., V. Wormskioldii R. ¢ S. Mission Creek to Blackfoot Glacier.

Veronica serpyllifolia L. Alta to Blackfoot Glacier.

Veronica serphyllifolia L. Alta to Blackfoot Glacier.

Synthyris rubra (Hook.) Bth. Mission Creek, Evaro, Ravalli, Ronan, Missoula (Elrod).

Gratiola Virginiana L. Bigfork, Wild Horse and Bull Islands, Polson (also by Miss Norton). Rost Lake (MacDougal).

Mimulus caespitosus Greene. Lambert Valley, Sperry to Blackfoot Glacier.

Mimulus Breweri (Greene) Rydberg. Alta.

Mimulus Langsdorfii Donn. Common Alta to Bigfork and MacDougal Peak.

Mimulus moschatus Dougl. Alta, Mission Creek, Evaro, Trail Creek (MacDougal).

Scrophularia nodosa var. **Marylandica** (L.) Gray. Ravalli, St. Ignatius Mission.

Pentstemon acuminatus Dougl. Alta, Deer Lodge Valley.

Pentstemon eriantherus Pursh., P. cristatus Nutt. Deer Lodge Valley, Missoula (Elrod).

Pentstemon attenuatus Dougl. Prairies on Wild Horse Island, Ravalli, Garrison, Ronan, Evaro.

Pentstemon procerus Dougl. Missoula, McDonald Lake in the Mission Mountains, Upper Marias Pass.

Pentstemon procerus var. **micrantus** (Nutt. Jour. Phil. Acad. 7 45 as species). Alta, Missoula (Elrod), Columbia Falls (Williams).

Pentstemon ovatus Dougl. Wild Horse Island, MacDougal Peak. Mission Mountains (MacDougal) as P. pinetorum.

Pentstemon Richardsonii Dougl. Alta, Como Peak, Missoula, Evaro.

Pentstemon Menziesii Hook. This is a very variable species and has received many names, but the *forms* all intergrade. Common on all the peaks *from Como Peak northward.*

Verbascum Thapsus *L. Bigfork*, Ravalli, Columbia Falls.

Verbascum Blattaria *L. St. Ignitaus* plains.

Utricularia vulgaris L. Bigfork. Also found previously by Elrod and Miss Norton.

Orobanche fasciculata Nutt. Bigfork, Wild Horse Island, Browning, Wild Horse Island (Elrod).

Orobanche comosa Hook. Hot Springs.

Plantago major L. Swan Lake, and all the settlements around Flathead Lake.

Plantago Tweedyi Gray. Deer Lodge Valley, Browning.

Plantago Purshii R. & S. Common on the low lands throughout.

Plantago Purshii var. **aristata** (Mx. Fl. 1 95 as species). Ravalli.

Galium Aparine L. Missoula, Ravalli.

Galium Aparine var. **Vaillantii** (DC.) Koch. Reported from McDonald Lake in the Mission Mountains by MacDougal.

Galium trifidum Mx. Common from Alta northward.

Galium asperrimum Gray. Alta, Darby.

Galium triflorum Mx. Common from Alta northward.

Galium boreale L. Common from Alta northward.

Sambucus pubens L. MacDougal Peak, Alta.

Sambucus melanocarpa Gray. Common from Alta northward.

Sambucus glauca Nutt. Bigfork and Yellow Bay.

Sambucus decipiens n. sp. This is what has passed for S. Canadensis throughout the Rocky Mountain region and has been called S. glauca by many because of the remarkably glaucous fruit. It differs from that species in the regular elderberry habit, namely, tufted and short-lived stems and very large leaves, and differs conspicuously from S. Canadensis in always having white-glaucous fruit. Berries 5-6 mm .wide. Joints of stems very prominent. Leaflets oblong-lanceolate, acuminate, smooth. Corymbs with 5-7 stout branches, the whole often 4.5 dm. wide and very heavy. Fruit almost black, pleasant. It grows in open clumps normally about 3.5 m. high, but is stouter than the eastern S. Canadensis, has larger leaves, and larger corymbs and fruit which is always glaucous. The type is from my specimens from St. Ignatius Mission, others are from the Hot Springs. Other all my material distributed from the West except my Californian material as S. glauca. Middle Temperate life zone. Ravalli, Alta, Mission Creek, Ravalli. Not S. Neo-Mexicana Wooton which is apparently S. Mexicana.

Linnaea borealis L. Everywhere in the woods.

Symphoricarpos racemosus Mx. Common in all localities.

Symphoricarpos rotundifolius Gray. S. vaccinioides Rydberg. Alta, Ronan, Ravalli, Evaro.

Lonicera Utahensis Wat. Frequent from Alta northward.

Lonicera involucrata Banks. Common from Alta northward.

Valeriana sylvatica Banks., V. septentrionalis Rydberg, V. occidentalis Heller. From Alta northward. Common.

Valeriana Sitchensis Bong. This is well marked in the extreme forms but seems to vary into the above. From Mission Creek to Blackfoot Glacier.

Echinocystis lobata (Mx.) T. & G. Bigfork and Ravalli. Cult.

Specularia perfoliata (L.) A. DC. Ravalli, Ronan, McDonald Lake, MacDougal.

Campanula rotundifolia L. Everywhere.

Heterocodon rariflorum Nutt. Ronan.

Lobelia Kalmii L. Rost Lake, Polson Swamp. Also by previous collectors.

Tragopogon porrifolius L. Bigfork.

Microseris nutans (Geyer) Sch. Mission Creek, Columbia Falls (Williams).

Hieracium gracile Hook. McDonald and MacDougal Peaks and through the Sperry Glacier region.

Hieracium cynoglossoides Arvet-Touv. Wild Horse Island, Ravalli, Evaro. This is a very doubtful species.

Hieracium Scouleri Hook. H. griseum Rydberg. Rydberg in making his untenable species goes directly in the face of the statement of Gray in the Synoptical Flora page 427 that Scouler distributed specimens of H. cynoglossoides as H. Scouleri, and in the face of Hooker's original description. Common from Alta northward.

Crepis glauca (Nutt.) T. & G. Deer Lodge Valley.

Crepis runcinata (James) T. & G. Bigfork, Ronan.

Crepis acuminata Nutt. Frequent from Alta northward.

Crepis intermedia Gray. A very poor species. Alta to Bigfork.

Crepis occidentalis Nutt. Garrison.

Prenanthes hastata var. **sagittata** (Gray Syn. Fl. 1 2 435 as alata var.). Frequent from Alta northward to Blackfoot Glacier.

Agoseris aurantiaca (Hook.) Greene. From Alta northward.

Agoseris gracilens (Gray) Greene. Published by Greene as gracilenta. Alta, MacDougal and McDonald Peaks. Hardly more than a variety of the above.

Agoseris grandiflora (Nutt.) Greene. Alta to Bigfork.

Taraxacum officinale Weber. Common as a noxious weed from Alta northward. The indigenous alpine variety rare in the Sperry Glacier region.

Lactuca Ludoviciana (Nutt.) DC. Bigfork and Mission Creek.

Lactuca pulchella (Pursh) DC. Common around Flathead Lake, always appearing as if an introduced plant.

Lactuca spicata (Lam.) Hitchk. Bigfork, Mission Creek, St. Ignatius Mission, Polson, Hot Springs.

Sonchus asper (L.) Hill. Bigfork, Hot Springs, Mission Creek.

Sonchus oleraceus L. Dayton.

Cirsium arvense (L.) Scop. Evaro, Deer Lodge Valley.

Cirsium Hookeriana Nutt. Alta and northward.

Cirsium Drummondii T. & G. Blackfoot Glacier.

Cirsium Hallii (Gray Proc. Am. Acad. 19 56 as Cnicus). Dayton, Hot Springs, Yellow Bay, St. Ignatius Mission.

Cirsium undulatum (Nutt.) Spreng. Ravalli to Bigfork, rather common.

Gnaphalium decurrens Ives. Darby, Columbia Falls (Williams), Swan Lake (Umbach).

Gnaphalium palustre Nutt. Frequent from Alta to Browning.

Antennaria luzuloides T. & G. Bigfork (Elrod), Columbia Falls (Williams).

Antennaria pulcherrima (Hook.) Greene. Ravalli.

Antennaria anaphaloides Rydberg. Evaro, McDonald Lake in the Mission Mountains, Upper Marias Pass.

Antennaria racemosa Hook. Alta to Blackfoot Glacier.

Antennaria Howellii Greene. Evaro.

Antennaria parvifolia Nutt. Garrison.

Antennaria rosea (Eaton) Greene. A very doubtful species. Bigfork, Alta, Evaro.

Antennaria Hendersoni Piper. Bigfork, Alta, Evaro, McDonald Peak.

Antennaria microphylla Rydberg. Somers, Missoula and Bigfork (MacDougal).

Antennaria media Greene. MacDougal Peak, Sperry to Blackfoot Glacier.

Antennaria umbrinella Rydberg. There is a striking difference in the bracts between this and the above but they do not seem to be distinct, in addition the clavellate pappus does not seem to hold Darby to Blackfoot Glacier.

Antennaria flavescens Rydberg. Missoula (Elrod). This material named by Rydberg differs materially from his description and is not at all flavescent and seems to be *A. parvifolia*. Alta, Evaro.

Adenocaulon bicolor Hook. Everywhere in the mountains to Gunsight Lake from Ravalli northward.

Artemisia dracunculoides Pursh. Kalispell, Dayton, Wild Horse Island, Elrod Peak (Elrod).

Artemisia frigida Willd. Hot Springs to Browning.

Artemisia biennis Willd. Whitefish, Browning.

Artemisia Ludoviciana Nutt. Common from Alta northward.

Artemisia Ludoviciana var. **atomifera** (Piper Fl. Wash. 588 as species). McDonald Peak.

Artemisia discolor Dougl. Blackfoot Glacier, Upper Marias Pass.

Artemisia discolor var. **incompta** (Nutt.) Gray. Gunsight Pass.

Artemisia tridentata Nutt. Alta, Little Bitter Root.

Artemisia rigida (Nutt.) Gray. Wild Horse Island, also by Elrod.

Artemisia absinthium L. Bigfork.

Matricaria discoidea DC. Common Alta and northward.

Chrysanthemum leucanthemum L. Ravalli as a bad weed.

Achillea Millefolium L. Alta and northward. The var. rosea also occurs.

Anthemis arvensis L. St. Ignatius Mission.

Senecio vulgaris L. Bigfork, Columbia Falls, Belton.

Senecio negacephalus Nutt. From McDonald Peak to Gunsight Pass.

Senecio integerrimus Nutt. Deer Lodge Valley, Missoula, Upper Marias Pass. Also MacDougal Peak MacDougal.

Senecio hydrophilus Nutt., S. hydrophiloides Rydberg. Evaro.

Senecio triangularis Hook., S. saliens Rydberg. Alta to Blackfoot Glacier. S. variifolius Rydberg is a more robust form.

Senecio hydrophilus Nutt., S. hydrophiloides Rydberg. Evaro.

Senecio lugens Rich. Alta.

Senecio Fremonti T. & G. MacDougal Peak to Blackfoot Glacier.

Senecio canus Hook. Missoula to Gunsight Pass.

Senecio subnudus DC. Mission Creek, Sperry to Blackfoot Glacier.

Senecio ovinus Greene. Sperry Glacier. Probably only a form of the above.

Senecio Balsamitae Muhl. Monida.

Senecio cymbalarioides Nutt. Lima and Monida, Stanton Lake (Williams), MacDougal and Silloway Peak (MacDougal).

Arnica Parryi Gray. MacDougal and McDonald Peaks.

Arnica longifolia Eaton. Alta to Blackfoot Glacier.

Arnica amplexicaulis Nutt. Whitefish. Mrs. Kennedy's specimen quoted by Rydberg as this species is A. foliosa.

Arnica foliosa Nutt. Bigfork and Swan Lake, Lambert Valley.

Arnica pedunculata Rydberg., A. monocephala Rydberg. Evaro.

Arnica betonicaefolia Greene. McDonald Peak, Lambert Valley, Blackfoot Glacier.

Arnica betanicaefolia var. **gracilis** (Rydberg Torr. Bull. 24 297 as species). A. multiflora Greene. McDonald Peak and Lake. Throughout the Sperry Glacier region.

Brichellia grandiflora Nutt. McDonald Peak and Lake, Lincoln Pass at Sperry Glacier.

Liatris punctata Hook. Browning.

Gutierrezia Sarothrae (Pursh) Britton. Deer Lodge Valley.

Grindelia nana Nutt. Ravalli, Flathead plains to Hot Springs.

Chrysopsis villosa (Pursh) Nutt. Ravalli and Garrison to Bigfork.

Bigelowia viscidiflora (Hook.) DC. Wild Horse Island, Polson.

Bigelowia nauseosa (Pall.) Jones. Alta to Browning, not common.

Solidago humilis Pursh. Browning. Elrod Peak (Elrod), Silloway Peak, *(MacDougal).*

Solidago confertiflora. Somers.

Solidago Tolmieana Gray. Elrod Peak ,Elrod), Bigfork(MacDougal).

Solidago Guiradonis Gray. Bull Island.

Solidago Missouriensis Nutt. Alta to Browning.

Solidago serotina Ait. Swan Lake (also Miss Norton and Umbach), Ravalli.

Solidago elongata Nutt. Bigfork, Rost Lake (MacDougal).

Solidago Canadensis L., S. caurina Piper. Alta to Browning.

Solidago Canadensis var. **salebrosa** (Piper Fl. Palouse 185 as species). This is a marked form intergrading with the type and differs in the heads being twice the size of those of the species. Without the intergrades it would be placed with S. serotina. Wild Horse Island, Mission Creek.

Solidago nemoralis Ait. Deer Lodge Valley.

Solidago occidentalis (Nutt.) T. & G. Bull Island, Echo Lake, Ravalli, Missoula (Elrod).

Hoorebekia acaulis (Nutt. Jour. Phil. Acad. 7, 33 as Chrysopsis). Ours is the var, caespitosa (Nutt. same cit. as Chrysopsis). Bigfork (Miss Norton.

Hoorebekia lanceolata (Hook. Fl. Bor. Am. 2 25 as Donia). Not yet reported.

Hoorebekia uniflora (Hook. l. c. as Donia). Browning.

Hoorebekia integrifolia (Porter Proc. Am. Acad. 16 79 as Aplopappus). Deer Lodge Valley, Upper Marias Pass.

Aster scopulorum Gray. Deer Lodge Valley.

Aster stenomeres Gray. Deer Lodge Valley and Big Hole country.

Aster Hallii Gray. Dayton.

Aster Fremonti (T. & G.) Gray. Swan Lake, St. Ignatius Mission.

Aster occidentalis Nutt. Bigfork and around Flathead Lake.

Aster foliaceus Lindl. Alta to Blackfoot Glacier.

Aster foliaceus var. Eatoni Gray. Bigfork, Wild Horse Island.

Aster Cusickii Gray. McDonald Peak.

Aster laevis L. Alta to Belton. The var. Geyeri at Alta.

Aster oblongifolius var. **rigidus** Gray. Upper Marias Pass.

Aster modestus Lindl. St. Ignatius Mission, Alta.

Aster radulinus Gray. Elrod Peak (Elrod).

Aster Sibiricus L. Blackfoot Glacier, Upper Marias Pass. Elrod Peak (Elrod).

Aster canescens Pursh. Deer Lodge Valley.

Erigeron armeriaefolius Turcz. Ledebour describes the two forms that Rydberg tries to separate. Alta.

Erigeron acris L. Bigfork.

Erigeron acris var. **draebachensis** (Mueller) Blytt. Lambert Valley and McDonald Lake.

Erigeron acris var. **debilis** Gray. Alta.

Erigeron alpinus L. Blackfoot Glacier. This is a well marked species.

Erigeron ramosus (Walt.) BSP. Bigfork, Ravalli, Garrison.

Erigeron divergens T. & G. Bigfork, Wild Horse Island, Ronan, Ravalli, Missoula.

Erigeron corymbosus Nutt. Bigfork, Wild Horse Island, Lima.

Erigeron glabellus Nutt. This is E. oblanceolatus Rydberg which may be distinct. Ravalli, Alta, Lambert Valley.

Erigeron speciosus DC. Alta and northward. Common.

Erigeron macranthus Nutt. Mission Creek, Blackfoot to Sperry Glacier. These two species are too close together.

Erigeron uniflorus L. Gunsight Pass, Elrod Peak (Elrod).

Erigeron grandiflorus Hook. Sperry to Blackfoot Glacier.

Erigeron concinnus (H. & A.) T. & G. Ravalli, Missoula, Wild Horse Island. Also by former collectors.

Erigeron ***filifolius*** *Nutt. Columbia* Falls (Williams), Polson (Umbach).

Townsendia Parryi *Gray. Garrison.*

Iva axillaris *Pursh. Ronan to Browning.*

Iva xanthiifolia Nutt. Belton, Hot Springs, St. Ignatius Mission. It acts like an introduced plant.

Xanthium Canadense Mill. Hot Springs, St. Ignatius Mission, Browning.

Rudbeckia occidentalis Nutt. Ravalli, Evaro.

Lepachys columnaris Sims. Ft. Missoula. Evidently introduced but well established.

Balsamorhiza Hookeri Nutt. Deer Lodge Valley.

Helianthus annuus L. Common.

Helianthus rigidus Desf. Dayton, Columbia Falls, Belton.

Helianthus Nuttallii T. & G. Dayton, Ravalli, Kalispell, Hot Springs.

Helianthus Californicus var. **Utahensis** Eaton. St. Ignatius Mission.

Coreopsis Atkinsoniana Lindl. Sand Point, Idaho, Whitefish.

Bidens cernua L. Ronan, Whitefish, Swan Lake, St. Ignatius Mission.

Madia exigua (Smith) Greene. Bigfork.

Madia glomerata Hook. Bigfork, St. Ignatius Mission, Hot Springs, Columbia Falls, Darby, Upper Marias Pass, Browning.

MOSSES.

Considerable attention has been given the moss flora, though the knowledge of the flora is not by any means complete.

In 1898 Professor John M. Holzinger devoted a season to the mosses of the Sperry Glacier region. In 1901 W. P. Harris devoted a season to the mosses of the vicinity of Flathead Lake. This material was identified by Carolyn M. Harris. In 1908 I also collected the more common mosses of the Lake and adjacent mountains, though no attempt was made to make it thorough, as my time was devoted to the higher plants chiefly.

All my material was identified by Mr. Holzinger, and the Harris material was examined by Mrs. Britton.

Fortunately Mr. Holzinger had prepared a manuscript of his Sperry Glacier mosses which I have prevailed on him to permit me to print in this report. It is so much more complete than the Harris or my list that it is given as prepared. I have added to it the localities and few additional species found on the Harris list and my own, always adding the name of Harris or Jones to all species collected by us, so that all other localities and notes may be known as those of Mr. Holzinger.

"In July, 1898, the writer, J. M. Holzinger, in company with Mr. James Blake, made a vacation trip into Northwest Montana, during which they collected the Mosses and Hepatics herewith published. The region visited is reached by the Great Northern railway, which we left at Belton, thirty miles east of Kalispell, striking some twenty miles north, to the north end of Lake McDonald. There we pitched our permanent camp. The country is very rugged and secluded. It is especially interesting because of the several glaciers which nestle among the precipitous mountain peaks. We visited only one of these, Sperry Glacier.

During our brief stay we made the following excursions: To Holzinger's Basin, eight miles east of camp, July 16 to 19; to McCrimmin Falls, on the McDonald Creek, near the upper end of the lake, July 20; to Mt. Trilby, four miles northwest of camp, July 21; to Sperry Glacier, twelve miles northeast of camp by way of Holzinger's Basin and the Rim, July 24 to 26; and to Avalanche Basin, below Sperry Glacier, 10 miles northeast of camp. A more detailed account of this interesting region may be found in the September number, 1900, of the Bulletin of the American Bureau of Geography.

The determination of the collection has been delayed for various reasons. *Dr. R. H. True has* determined most of the Dicrana; Dr. H. J. Grout, the *Eurhynchia and Brachythecia*, and several other species; Dr. G. N. Best, the *Prendoleskear, etc.;* Dr. C. Warnstork the Sphagna; Mr. Renauld, the Har*pidia; Mrs. Britton* has determined the Orthotrica, and has critically examined a considerable number of species submitted, especially Grimmias and Mniums. Messrs. Cardot and Theriot have generously examined and determined a promiscuous lot of things. Dr. A. W. Evans has determined all the Hepaticae. To all these persons I herewith express my gratitude for their generous and ever cordial assistance. Since I have been able to do comparatively little toward determining this collection, the credit for the work is due the more largely to my biological friends.

"The numbers in this report refer to a set of mosses from this collection which were distributed in 1899."

From manuscript by Professor J. M. Holzinger.

In the Botanical Gazette of Aug., 1900, were published 13 species and varieties of mosses from this collection, being either new or new to North America. They are again inserted in the general list herewith submitted.

Sphagnum acutifolium var. **viride** W., form pusillum. W. Base of Sperry Glacier.

Sphagnum acutifolium var. **versicolor** form pusillum W. Base of Sperry Glacier.

Sphagnum molle Sull. Base of Sperry Glacier.

Sphagnum molle, form **squarrosulum** Gravet. Base of Sperry Glacier.

Sphagnum robustum Roell. Forms **Fibrosum** and **pallido-flavescens** Roell. (Identified by Dr. Julius Roell). "Interesting by reason of the numerous fibers, and the single pores in the branch leaves, by its pale cortex and low stature, all high altitude characters." This grew in the cold water at the camping place below the rim, Sperry Glacier, alpine.

Andreaea petrophila Ehrh. Banks of McDonald Creek near McCrimmin Falls, Sperry Glacier region.

Andreaea alpestris Sch. Mt. Trilby and Mt. Stanton.

Dicranoweisia cirrhata Lindb. Mt. Trilby and Mt. Stanton.

Dicranoweisia contermina Ren. & Card. Holzinger Basin, Mt. Trilby.

Dicranoweisia subcompacta Card. & Ther. in Bot. Gaz. 29 122 (1900). Along the trail from Holzinger Basin to the Rim, which is the highest ledge of rock in the ascent from Holzinger Basin to Sperry Glacier.

Dicranoweisia cirrhata Lindb. Sperry Glacier and Darby (Jones).

Cynodontium polycarpum B. S. Holzinger Basin.

Cynodontium polycarpum var. **strumiferum** B. S. McCrimmin Falls, head of Lake McDonald, Sperry Glacier region. Also by Jones at Swan Lake.

Cynodontium virens B. S. Sperry Glacier (Jones).

Dicranum undulatum Ehrh. Belton (Jones).

Dichodontium pellucidum Sch. a form. Holzinger Basin.

Dicranum Bonjeani De Not. Avalanche Basin. Also by Harris at McDonald Lake in the Mission Mountains, and by Jones at foot of MacDougal Peak, Bigfork and Yellow Bay. Alta and McDonald Lake in the Mission Mountains.

Dicranum fragilifolium Lindb. Holzinger Basin, Mt. Trilby. Also by Harris at Mud Creek and McDonald Lake in the Mission Mountains, and by Jones at Bigfork and Somers.

Dicranum falcatum Hedw. Avalanche Basin, Sperry Glacier, Holzinger Basin.

Dicranum fuscescens Turn. Mt. Stanton and Mt. Trilby. Also at Bigfork (Jones).

Dicranum fuscescens var. **Eatoni** Ren. & Card. Base of Sperry Glacier.

Dicranum fuscescens Turn. a form approaching D. trachyphyllum Ren & Card. Mts. Stanton and Trilby.

Dicranum Howellii Ren. & Card. Mt. Trilby.

Dicranum longifolium Hedw. Avalanche Trail. McCrimmin Falls.

Dicranum ***neglectum*** *Juratz.* McCrimmin Falls at the north end of Lake *McDonald, and along the trail to the river.*

Dicranum scopariiforme *Kindb.* Mt. Trilby, Avalanche Basin.

Dicranum scoparium *Hedw.* Avalanche Basin.

Dicranum Starkei Web. & Mohr. Holzinger Basin and from there to the Rim and Sperry Glacier.

Dicranum strictum Schleich. O'Keefe canon, Harris. Also Bigfork and Somers, Jones. Lake McDonald and Swan Lake (Jones).

Dicranella squarrosa (Schrad.) W. P. Sch (Fide Dr. Best). Blackfoot Glacier (Jones).

Fissidens bryoides var. **gynandrus** (Buse) R. Ruthe.Shores of Lake McDonald and Avalanche trail, Sperry Glacier region.

Ceratodon purpureus (L.) Brid. Common everywhere in Sperry Glacier region. Mud Creek, Harris; Bigfork and Belton (Jones).

Distichium capillaceum B. S. Mts. Stanton and Trilby. McDonald Peak in the Mission Mountains, Big fork and Sperry Glacier (Jones). Subalpine (Jones).

Barbula ruralis Hedw. a form. Mts. Stanton and Trilby. O'Keefe canon and McDonald Lake in the Mission Mountains (Harris).

Barbula Mulleri (Br.) B. S. Wild Horse, Bigfork, Alta and Somers (Jones).

Schistidium alpicola (Sw.) Limpr. Mts. Stanton and Trilby.

Barbula aciphylla B. S. Base of Sperry Glacier.

Barbula rufipila Card. & Ther. Bot. Gaz. 29 123 (1900). Avalanche Basin and Holzinger Basin.

Barbula ruralis Hedw. (?) Sperry Glacier (Jones).

Scouleria aquatica Hook. In the Creek through Holzinger Basin, Avalanche Creek.

Schistidium alpicola (Sw.) Limpr. Mts. Stanton and Trilby.

Schistidium confertum (Funck) B. S. Base of Sperry Glacier.

Schistidium gracile (Schleich.) Limpr. Holzinger Basin and Mts. Stanton and Trilby.

Schistidium alpicola var. **rivulare** (Brid.) Wahl. Avalanche Basin, near the Rim at the base of Sperry Glacier.

Grimmia alpestris Schleich. Holzinger Basin, Avalanche Basin, Sperry Glacier.

Grimmia commutata Hub. Mts. Stanton and Trilby.

Grimmia Doniana Sm. Mts. Stanton and Trilby.

Grimmia Holzingeri Card. & Ther. Bot. Gaz. 29 123 (1900). Base of Sperry Glacier and Mt. Trilby.

Grimmia mollis B. S. Base of Sperry Glacier.

Grimmia subsulcata Limpr. in Rabenh. Crypt.. Fl. Laubm, 757. Mt. Trilby.

Grimmia montana B. S. Bigfork, Harris; Wild Horse Island (Jones).

Grimmia calyptrata Hook. Missoula (Harris).

Grimmia tenerrima Ren. & Card. Mt. Trilby, Sperry Glacier, Avalanche Basin.

Grimmia torquata Grev. Mts. Stanton and Trilby.

Grimmia sphaerica Sch. Sperry Glacier (Jones.)

Rhacomitrium canescens Brid. Mts. Stanton and Trilby. Bigfork (Harris).

Rhacomitrium canescens var. **ericoides** Brid. Holzinger Basin.

Rhacomitrium heterostichum Brid. Holzinger Basin.

Rhacomitrium aciculare Brid. Sperry Glacier.

Rhacomitrium patens Hub. Holzinger Basin.

Rhacomitrium Sudeticum B. S. Holzinger Basin. Sperry Glacier, McDonald Peak at 5500° alt. (Jones).

Encalypta contorta (Wulf.) Lindb. McDonald Peak at 5500° alt. (Jones).

Encalypta Macounii Aust. McDonald Lake in the Mission Mountains *(Harris).*

Encalypta rhabdocarpa Schwaegr. Bigfork (Jones).

Hedwigia ciliata (Dicks) Ehrh. Mts. Stanton and Trilby. Bigfork *(Jones).*

Orthotrichum obtusifolium Schrad. On Cottonwoods along Avalanche Trail.

Orthotrichum Schlotthauxeri Vent. Mts. Stanton and Trilby.

Orthotrichum speciosum Nees. Shores of Lake McDonald, Sperry Glacier region. Lake McDonald in the Mission Mountains (Harris). Alta (Jones).

Orthotrichum Kingeanum Lesq. Wild Horse Island (Jones).

Orthotrichum rupestre Schleich. McDonald Lake in the Mission Mountains (Harris).

Orthotrichum affine Schrad. Sperry Glacier (Jones).

Orthotrichum speciosum Nees. (Fide Dr. Best). Sperry Glacier and Swan Lake (Jones).

Orthothecium chryseum Sch. Sperry Glacier (Jones).

Amphidium Californicum L. & J. Mt. Stanton.

Amphidium Papponicum Sch. Base of Sperry Glacier, Mt. Trilby.

Amphidium Mougeottii Sch. On trail from Holzinger Basin to the Rim.

Tetraphis pellucida Hedw. Avalanche Basin and Trail. Bigfork, Yellow Bay and Somers (Jones).

Splachnum luteum L. Bigfork (Jones).

Schistotega osmundacea Web. & Mohr. Trail to Holzinger Basin.

Tayloria serrata B. S. Avalanche Basin.

Funaria hygrometrica (L.)Hedw. Shores of Lake McDonald near McCrimmin Falls. Bigfork and Sperry Glacier (Jones).

Bartramia ithyphylla Brid. Mt. Trilby.

Bartramia Oederi (Gunn.) Schwaegr. Bigfork and McDonald Peak (Jones).

Bartramia pomiformis Hedw. Holzinger Basin. Bigfork (Jones).

Conostomum boreale Sm. Base of Sperry Glacier.

Philonotis fontana var. pumila (Turn.) Dix. Mt. Trilby, Avalanche Basin.

Philonotis fontana Brid. a form heterophylla. On the way to the Rim. A plant from Mt. Edwards near the Rim Mr. Dixon determined as an alpine form of P. fontana approaching P. adpressa Ferguss.

Philonotis fontana var. **alpine** Brd. Blackfoot Glacier (Jones).

Philonotis seriata Mitt. Sperry Glacier.

Philonotis glabriuscula Kindb. Sperry Glacier (Jones).

Webera albicans Sch. a form. Base of Sperry Glacier. Blackfoot Glacier (Jones).

Webera carinata (Brid.) (W. cucullata var. carinata Hurnot). New to North America. Base of Sperry Glacier.

Webera commutata Sch. This approaches close to Bryum filum Sch. which is only a form of W. commutata according to Carnot. Base of Sperry Glacier.

Webera crudis (L.) Sch. Avalanche Basin where it is quite abundant. Bigfork, Blackfoot Glacier and Lamber Valley (Jones).

Webera nutans Hedw. Holzinger Basin and Trail, Mt. Trilby, Avalanche Trail. Also O'Keefe canon (Harris) and Sinyaleamin Lake, Sperry Glacier (Jones).

Leptobryum pyriforme Sch. O'Keefe canon (Harris). Sperry Glacier (Jones).

Bryum alpinum var. **denticulatum** Card. & Ther. Bot. Gaz. 29 123 (1900). On the way from Holzinger Basin to the Rim.

Bryum pallescens Schleich. Mts. Stanton and Trilby.

Bryum pallens Sw. (B. distantifolium R. & C.). (Fide Dr. Best). Swan Lake and Sperry Glacier (Jones).

Bryum lucidum Britton. Shores of Lake McDonald, Sperry Glacier region, near the lower end.

Bryum Duvalli Volt. *On the trail* to the Rim on Mt. Edwards.

Bryum barbatum *Wils. The same* (?) as B. Stertoni Sch. Plants very *close to this species but not fully* agreeing with it. Base of Sperry Glacier.

Bryum Atwateriae C. Mull. The plants distributed as this species do not fully agree with it and may prove distinct. Mts. Stanton and Trilby.

Bryum caespiticium L. Bigfork (Jones).

Bryum cirrhatum H. & H. Sperry Glacier (Jones).

Bryum purpurascens B. S. Sperry Glacier (Jones).

Bryum Duvalii var. latodecurrens C. M. et Kindb. Swan Like (Jones).

Bryum three species too old for determination. Bigfork and Swan Lake (Jones).

Meesia Albertini B. S. (Fide Dr. Best). Blackfoot Glacier (Jones).

Mnium nudum Williams. Avalanche Basin.

Mnium punctatum var. elatum B. S. Avalanche Basin. McDonald Lake in the Mission Mountains (Harris).

Mnium spinulosum B. S. Avalanche Basin, McDonald Lake in the Mission Mountains (Harris), Bigfork, MacDougal Peak, Lake McDonald and Swan Lake (Jones).

Mnium venustum Mitt. Mts. Trilby and Stanton. The plants appear to be dioecious. McDonald Lake in the Mission Mountains (Harris).

Mnium insigne Mitt. McDonald Lake in the Mission Mountains (Harris).

Mnium orthorhynchum B. S. McDonald Lake in the Mission Mountains (Harris), Lake McDonald (Jones).

Mnium affina Bland. McDonald Lake in the Mission Mountains (Harris), Somers (Jones).

Mnium Blyttii B. S. Sperry Glacier (Jones).

Aulacomnium palustre Schew. Holzinger Basin.

Aulacomnium androgynum Schw. Holzinger Basin, Mt. Trilby. McDonald Lake in the Mission Mountains (Harris), Bigfork, Alta and Browning (Jones).

Timmia austriaca Hedw. Holzinger Basin.

Timmia austriaca var. brevifolia Ren. & Card. Trail to Holzinger Basin.

Timmia megapolitana Hedw. Mud Creek and McDonald Lake in the Mission Mountains (Harris).

Catharinaea Selwyni (Aust.) Kindb. Avalanche Trail, O'Keefe canon (Harris), Bigfork (Jones).

Tortula ruralis Ehrh. O'Keefe canon and McDonald Lake in the Mission Mountains (Harris).

Pogonatum alpinum Roehl. Avalanche Basin below Little Matterhorn.

Pogonatum alpinum var. arcticum Brd. Blackfoot and Sperry Glaciers and McDonald Lake, Mission Mts. (Jones).

Pogonatum alpinum var. simplex Sch. Sperry Glacier (Jones).

Pogonatum alpinum Roehl. (?) Forms with nearly entire leaves. Sperry Glacier (Jones).

Polytrichum juniperinum (Hedw.) Willd. Avalanche Basin. (Also Umbach), Bigfork, Alta, Belton, Blackfoot Glacier, Lake McDonald, McDonald Lake in the Mission Mountains (Jones).

Polytrichum angustidens Lindb. fil. (See Bryologist for March, 1905, Vol. 8, p. 30. Note). Leaf section and calyptra are distinctive for this species. The author did not refer to the calyptra, the type specimens, collected by Dr. Sandberg in Idaho in 1891, being old. These specimens of Jones show the calyptra very short, covering hardly more than the operculum, an important additional character.—J. M. H. MacDougal Peak, alpine (Jones).

Polytrichum piliferum Schreb. Base of Sperry Glacier, Mt. Trilby, Holzinger Basin. O'Keefe canyon (Harris).

Polytrichum sexangulare Floerke. Base of Sperry Glacier. Blackfoot Glacier (Jones).

Polytarichum strictum Menz. Base of Sperry Glacier. (Also Umbach). Sperry Glacier and McDonald Lake in the Mission Mountains (Jones).

Polytrichum formosum Hedw. Alta (Jones).

Neckera Menziesii Hook. Mts. Stanton and Trilby and McCrimmin Falls, Bigfork (Jones).

Neckera Douglasii Hook. McDonald Lake in the Mission Mountains (Harris).

Climacium Americanum Bird. Bigfork and Lake McDonald (Jones).

Climacium dendroideum (L.) Web. & Mohr. McDonald Lake in the Mission Mountains (Harris), Bigfork, Swan Lake and Mission Creek (Jones).

Fontinalis antiphyretica L. alpine form. Avalanche Trail, Mud Creek (Harris), Hot Springs (Jones).

Dichelyma uncinatum Mitt. Trail to Mt. Stanton.

Pterigynandrum filiforme Hedw. Mts. Stanton and Trilby, Avalanche Trail. Bigfork and McDonald Lake in the Mission Mountains (Jones).

Homalothecium Nevadense Ren. & Cardot. Mts. Stanton and Trilby.

Homalothecium Nevadense var. **subulatum** Ren. & Cardot. Mt. Trilby.

Pseudoleskea radicosa (Mitt.) Lesq. & James. Trail to Holzinger Basin.

Pseudoleskea rigescens Lindb. Holzinger Basin, Mt. Trilby.

Pseudoleskea denudata var. **Holzingeri** Best, in Torr. Bull. 27 229 (1900). Avalanche Basin, Holzinger Basin, Mt. Trilby.

Pseudoleskea atricha Kindb. (Fide Dr. Best). Blackfoot Glacier, Sperry Glacier (Jones).

Pseudoleskea congesta (Wils.) Bry. Eur. (Fide Dr. Best). Blackfoot Glacier (Jones).

Pseudoleskea atrovirens Sch. Blackfoot Glacier (Jones).

Heterocladium procurrens L. & J. Mt. Stanton and Mt. Trilby.

Claopodium Bolanderi Best. Mts. Stanton and Trilby.

Camplothecium lutescens (Huds.) B. S. Bigfork and Wild Horse Island and Alta (Jones).

Camplothecium aeneum (Mitt.) Jacq. Old Stage Station on east side of Flathead Lake on Pinus ponderosa (Harris).

Campylothecium Nuttallii Sch. Alta.

Brachythecium collinum B. S. Mts. Stanton and Trilby.

Brachythecium Leibergii Grout. Holzinger Basin.

Brachythecium rivulare Sch. Avalanche Basin.

Brachythecium salebrosum Sch. Avalanche Basin.

Brachythecium Starkei Sch. Holzinger Basin.

Brachythecium rutabulum var. **flavescens** (Brid.) B. S. Bigfork (Jones), Det. by Dr. J. Grout.

Eurhynchium strigosum B. S. McDonald Lake in the Mission Mountains (Harris). Lkae McDonald (Jones).

Eurhynchium strigosum var. **fallax** Ren. & Cardot. Common on trail to Holzinger Basin.

Thamnium Neckeroides Sch. Trail to Holzinger Basin.

Plagiothecium denticulatum Sch. Holzinger Basin, Mt. Trilby.

Plagiothecium denticulatum var. **microcarpum** Ren. & Card. Avalanche Basin and Trail.

Plagiothecium filiferum Sch. Holzinger Basin, Mt. Trilby, Avalanche Trail.

Plagiothecium olegans Sch. McDonald Lake in the Mission Mountains (Harris).

Plagiothecium sylvaticum Sch., ? Holzinger Basin, Avalanche Trail.

Plagiothecium Sullivantii Sch. Lake McDonald (Jones).

Plagiothecium Millerianum Sch. Lake McDonald (Jones).

Plagiothecium Millerianum Hook. f. (Fide Dr. Best). Lake McDonald (Jones).

Amblystegium varium (Hedw.) Lindb. Mud Creek (Harris), Bigfork (Jones).

Amblystegium varium var. **orthocladon** (L. & J.) form alpinum. Base of Sperry Glacier. (This has been published as new, A. Montanum Bryhn Bryologist, March, 1902, p. 26).

Amblystegium serpens *(Hedw.) B S.* Bigfork (Jones).

Hypnum aduncum *Hedw. Bigfork* and Sperry Glacier (Jones.)

Hypnum aduncum *group* ***Kneiffii.*** Base of Sperry Glacier.

Hypnum Bestii Ren. & Bryhn in Bryologist Jan. 1901 p. 12, also April 1901 p. 21, 22. In water, along Avalanche Trail.

Hypnum Cardoti Ther. in Bot. Gaz. Aug. 1900 Vol. 29 p. 124. Avalanche Basin.

Hypnum fluitans L. Daphnia Lake (Harris, also Jones), Sperry Glacier (Jones).

Hypnum fluitans var. **brachydictyon** Ren. in Hurnot Mus. Gall. form Holzingeri Ren. in Bot. Gaz. Aug. 1900 Vol. 29 p. 124. Base of Sperry Glacier.

Hypnum callichroum Brid. Yellow Bay (Jones).

Hypnum giganteum Sch. Mud Creek (Harris), Polson Swamp (Jones).

Hypnum molle Dicks. In water along trail to Holzinger Basin, base of Sperry Glacier.

Hypnum molle var. **Schimperianum** Lortz. In water near the top of Mt. Trilby.

Hypnum ochraceum Turn. Holzinger Basin.

Hypnum ochraseum form tenue. On the way to the Rim at the base of Sperry Glacier.

Hypnum ochraceum var. **uncinatum** Milde. A European moss new to North America. Holzinger Basin.

Hypnum subimponens Lesq. Bigfork (Jones).

Hypnum hamulosum B. S. Bigfork (Jones).

Hypnum polygamum Wils. Bigfork and Somers (Jones).

Hypnum reptile Mx. Bigfork (Jones).

Hypnum uncinatum Hedw. Holzinger Basin and Trail, Mt. Trilby, McDonald Lake in the Mission Mountains (Harris), Somers (Jones).

Hypnum uncinatum form **plumosum.** Mt. Trilby.

Hypnum uncinatum var. **subjulaceum** Sch. form Holzingeri Ren. in Bot. Gaz. 29 p. 125 (1900). Base of Sperry Glacier.

Hypnum uncinatum var. **plumulosum** B. S. Bigfork (Jones).

Hypnum cuspidatum L. Mud Creek (Harris).

Hypnum Schreberi Willd. Holzinger Basin. Somers, Yellow Bay and Bigfork (Jones).

Hypnum stellatum var. **protensum** Sch. Avalanche Basin.

Hypnum symmetricum Ren. & Card. McCrimmin Falls at upper end of McDonald Lake, Sperry Glacier region.

Hypnum crista-castrensis L. Bigfork and Lake McDonald (Jones).

Hypnum circinale Hook. McDonald Lake Mission Mts. (Jones).

Hypnum filicinum. Blackfoot Glacier (Jones).

Hypnum pratense Koch. Sperry Glacier (Jones).

Hylacomium proliferum (L.) Lindb. Avalanche Trail, McDonald Lake in the Mission Mountains (Harris), Yellow Bay (Jones).

Hylacomium robustum Kindb. Shores of Lake McDonald, Sperry Glacier region. Bigfork and McDonald Lake in the Mission Mountains (Jones).

Hylacomium aplendens Sch. Avalanche Trail. Lake McDonald (Jones).

Hylacomium squarrosum Sch. Avalanche Basin.

Hylacomium triquetrum Sch. Avalanche Basin, Yellow Bay and Bigfork, Belton and Lake McDonald (Jones).

Limnobium bestii Ren. & Bryhn. Blackfoot Glacier (Jones).

"**Dicranoweisia subcompacta** Card. et. Ther., sp. nova.—Dense pulvinato-caespitosa. Caulis simplex vel parcissime ramosus, 6-8 mm. altus dense foliosus. Folia madida suberecta, sicca crispatula, 1-1.5 mm longa, oblongo lanceolata, acuminata, subacuta vel obtusiuscula, superne, canaliculata, nervo basi attenuato usque ad apicem producto vel paululum infra evanido, marginibus inferne planis, superne inflexis, integerrimis, cellulis, irregulariter quadratis vel subrectangularibus, inferioribus laxioribus, juxta costam linearibus, alaribus distinctis, subinflatis, fuscis. Caetera ignota.

"Very nearly allied to the European **D. compacta** Sch., from which it differs by the leaves being more narrowly acuminate and generally subacute, the cells of the areolation larger and with thinner walls, and chiefly by the costa narrower, attenuate below (16 to 25 u broad; it is 55 u in **D. compacta**). Along the trail from Holzinger's Basin to the Rim.

"**Barbula rufipila** Card. et Ther., sp. nova.— **B. aciphyllae** habitu et. foliorum forma omnino similis, differt tantum cellulis duplo majoribus et piloque saepius minus denticulata interdum integro. Specimina sterilia. magis distinctis (superioribus 20-30 u in **B. rufipila**, 12-15 u in **B. aciphylla**) Avalanche Basin, Holzinger's Basin.

"**Fissidens bryoides gymnandrus** (Buse) R. Ruthe. New to North America. Cardot det. Shores of Lake McDonald, Avalanche Trail.

"**Grimmia Holzingeri** Card. et Ther., sp, nova. Minima, tenella, pulvinatula, obscure viridis, inferne fusca. Caulis erectus, 4-6 mm. altus, parce ramosus. ramis interdum attenuatis, subflagellaceis. Folia conferta, minima, 0.50-0.70 mm. longa, 0.20-0.35 lata, madida erecta, sicca appressa, breviter ovato-oblonga, concava, omnia mutica obtuse acuminata, marginibus planis integris, costa canaliculata, usque ad apicem producta, basi 28 u lata, cellulis superioribus bistratosis, quadrato-subrotundatis; inferioribus unisthatosis majoribus, lutescentibus, infimis oblongis vel sublinearibus, omnibus incrassatis. Caetera ignota. This very minute species, resembling in habit the small form of **Andreaea jetrophila**, is quite distinct from all the European and North American species of Grimmia with muticous leaves by the small size, and the shape and areolation of the leaves. Base of Sperry Glacier, Mt. Trilby.

"**Grimmia Mollis** B. S. This European alpine moss is reported from Greenland, and should be found at intermediate stations in Canada. Base of Sperry Glacier. No. 17.

"**Grimmia subsulcata** Limpr. in Rabenh. Crytog. Fl., Laubm, 747. New to North America. Cardot det. Mt. Trilby.

"**Webera carinata** (Brid.) (**W. cucllata carinata** Husnot; **Bryum naviculare** Cardot). New to North America. Cardot det. Base of Sperry Glacier.

Bryum alpinum L., var. **denticulatum** Card. et Ther., n. var. A forme typica differt habitu graciliore, foliis ovato-acuminatis, brevioribus, marginibus parum revolutis, superne distincte sinuato-denticulatis, costaque longe ab apice dissoluta. On the way from Holzinger's Basin to the Rim.

"**Pseudoleskea radicosa** (Mull.) Lesq. & James. This species was distributed as **P. regiscens** Lindb.: it is the **P. atrovirens** of European authors. Best det. Holzinger's Basin; Mt. Trilby. No. 46.

"**Pseudoleskea denudata Holzingeri** Best. in Bull. Torr. Bot. Club 27:229, May 1900. Holzinger's Basin, Mt. Trilby, Avalanche Basin.

"**Hypnum Cardoti** Ther., sp, nova. Polygamum, olivaceo-viride, molle, laxiuscule depresso-caespitosum. Caulis procumbens vel ascendens, irregulariter ramosus, 2-4 cm. longus. Folia remotiuscula, patulosquarrosa, interdum subsecunda, e basi constricta anguste decurrente late ovate-deltoidea, subito in acumen angustum breviusculum recurvum protracta, circa 1.5 mm. longa et o.75 lata, marginibus planis fere undique sinuato-denticulatis, costa simplici-bifurcata vel gemella, crure longiore ad medium producto, cellulis laxiusculis linearibus subflexuosis, basilaribus brevioribus et latioribus, alaribus laxis majoribus subhyalinis. Folia perichaetialia externa ovato-lanceolata, breviter acuminata, subintegra, enervia, intima plicata, costata. Capsula in pedicello rubente valde flexuoso, circa 18 mm. longo, subhorizontalis, arcuata, operculo convexo apiculato. This species is near **H. stellatum** Schreb. and **H. polygamum** Sch. From the first it is at once distinguished by the polygamous inflorescence and the softer leaves with a shorter acumen and a looser areolation. The shape of the stem leaves and of the perichaetical leaves distinguishes it from the small forms of the second species. Avalanche Basin.

"**Hypnum fluitans** L., var. **brachydictyon** Ren. in Husnot Musc. Gall., forma ***Holzingeri* Ren.** *Voisin de la* var. **brachydictyon** Renauld, n'en differe que *par le port plus grele*, la nervure plus etroite, et el tissu delicat. Dioiquell. *Cette var., essentiellement* alpine, n'avait pas encore, je crois, ete signale en Amerique. A cause de la brievete des cellules medianes, on pourrait confondre cette forme avec **Hypnum aduncum** Hedw.; mais le passage brusque des cellules foliaires de la base aux cellules superficielles de la tige permet d' eviter la confusion. Base of Sperry Glacier.

"**Hypnum ochraceum uncinatum** Milde. A European alpine moss, new to North America. Renauld det. Holzinger's Basin.

"**Hypnum uncinatum** Hedw., var. **subjulaceum** Sch., forma **Holzingeri** Ren. Forme voisine de la forme **orthothecioides** Lindb.; en differe par la couleur verte, les touffes compactes encombrees de terre a la base, l'acumen plus court denticule et le tissu plus delicat, non paisse. Base of Sperry Glacier.

Minor extensions of range will be noted in a fuller report on this collection."—John M. Holzinger, Winona, Minn. Bot. Gaz., Aug., 1900, pp. 122-125.

HEPATICAE, LIVERWORTS.

This list is furnished by J. M. Holzinger of the Minnesota State Normal. Determined by Dr. A. W. Evans.

Asterella gracilis (Web.) Underwood. Sperry Glacier (Jones).

Anthelia julacea (Lightf.) Spruce. Sperry Glacier (Jones).

Blepharostoma trichophyllum (L.) Dumort. Holzinger Basin and Mt. Trilby.

Cephalozia bicuspidata (L.) Dumort. Shores of Lake McDonald, Sperry Glacier region.

Cephalozia media Lindb. Shores of Lake McDonald and Sperry Glacier region.

Chiloschypus polyanthos (L.) Corda. Mostly the var. rivularis Neck. Holzinger Basin and Lake McDonald, Sperry Glacier region.

Gymnomitrium obtusum (Lindb.) Pearson. This species has been reported from Greenland only in America. Mt. Trilby.

Harpanthus flutonianus Nees. A few stems only were found mixed with Scaphania undulata. Holzinger Basin.

Jungermannia barbata Schreb. Shores of Lake McDonald, Sperry Glacier region.

Jungermannia Floerkei Web. & Mohr. Holzinger Basin.

Jungermannia lycopodioides Wallr. Holzinger Basin and Avalanche Basin.

Jungermannia ventricosa Dicks. Very variable and common throughout the Sperry Glacier region.

Jungermannia cordifolia Hook. Blackfoot Glacier (Jones).

Lepidozia reptans (L.) Dum. Shores of Lake McDonald and Mt. Trilby.

Marsupella sphacelata (Gieseke) Dum. Shores of Lake McDonald, Sperry Glacier region.

Metzgeria pubescens (Schrank) Raddi. Avalanche Basin, Holzinger Basin and Lake McDonald.

Porella rivularis (Nees) Trevis. Avalanche Basin, Mt. Trilby and shores of Lake McDonald. Also Bigfork (Jones).

Ptilidium ciliare (L.) Nees. Common at all stations.

Ptilidium Californicum (Aust.) Pearson. Mt. Trilby the eastermost station of the species.

Radula complanata (L.) Dumort. Avalanche Basin, Holzinger Basin, and shores of Lake McDonald.

Scapania nemorosa (L.) Dumort. Shores of Lake McDonald, Sperry Glacier region.

Scapania undulata (L.) Dumort. Holzinger Basin and shores of Lake McDonald.

Marchantia polymorpha L. Belton (Jones).

Pleuroclada albescens (Nees) Spruce. Sperry Glacier (Jones).

In addition to the Hepaticae given above there were found specimens of a sterile ***Anthelia,*** *and of a sterile* **Nardia** or **Aplozia.**

LICHENS.

During the past season no attempt was made to collect lichens, though a few were picked up here and there. The following list is taken mostly from Bulletin No. 19 Biological Series No. 7 of the University, published by Wilson P. Harris and Carolyn W. Harris, as a result of botanizing in this region in 1901, mostly, together with other species collected by Prof. M. J. Elrod. Plants of the Middle Temperate life zones if not otherwise stated.

Acolium tympanellum (Ach.) De Not. Bigfork, Rost and Echo Lakes.

Alectoria jubata (L.) 9815 Jones. Swan Lake.

Alectoria jubata var. **chalybeiformis** Ach. O'Keefe canon.

Alectoria ochroleuca (Ehrh.) var. **rigida** Fr. O'Keefe canon.

Alectoria ochroleuca var. **sarmentosa** Nyl. Rost Lake, Sinyaleamin Lake. Craig Mt. where it is subalpine. MacDougal Peak Elrod, Jones also.

Alectoria Fremontii Tuck. Sinyaleamin Lake, Missoula (Elrod). This is the common black moss, which is particularly abundant on forests at high elevation.

Baeomyces aeruginosus (Scop.) DC. Wolf Creek and Craig Mt. The latter alpine.

Biatora Paddensis Tuck. O'Keefe canon and Rost Lake.

Biatora decipiens (Ehrh.) Fr. Mission Mts.

Biatora rufonigra Tuck. Silloway Peak, alpine.

Buellia petraea (Flot. Koerb) Tuck. var. **Montagnoei Tuck.** On rocks. Missoula (Elrod).

Buellia geographica (L.) Tuck. McDonald Lake in the Mission Mountains.

Buellia oidalea Tuck. Rost Lake.

Calicium quercinum Pers. Echo Lake.

Cetraria platyphylla Tuck. O'Keefe canon, Sinyaleamin Lake, Lolo Hot Springs (Elrod). First two localities Middle Temperate.

Cetraria ciliaris (Ach.) Tuck. Lolo Hot Springs (Elrod).

Cetraria glauca (L.) Ach. O'Keefe canon, McDonald Lake in the Mission Mountains, Mud Creek, Swan Lake, Sinyaleamin Lake. Also Lolo Hot Springs (Elrod), (9817 Jones) Swan Lake.

Cetraria Juniperina (L.) Ach. Sinyaleamin Lake, Swan Lake. Also Lolo Hot Springs (Elrod).

Cladonia amaurocraea (Ll.) Schaer. McDonald Lake Mission Mountains.

Cladonia caespiticia (Pers.) Fl. Silloway Peak, alpine.

Cladonia amaurocraea (L.) Schaer. McDonald Lake Mission Mountanns.

Cladonia crispata var. infundibulifera (Schaer.) Wahl. McDonald Lake in Mission Mountains.

Cladonia coccifera var. **pleurota** (Flk.) Willd. McDonald Lake, Mission Mts.

Cladonia cornuta (L.) Fr. McDonald Lake, Mission Mountains.

Cladonia deformis (L.) Hoffm. Sinyaleamin Lake.

Cladonia digitata (L.) Hoffm. Flathead Lake.

Cladonia fimbriata (L.) Fr. Flathead Lake and Lolo Hot Springs (Elrod) on decaying logs. Swan Lake, Jones.

Cladonia fimbriata var. **radiata** Fr. Missoula (Elrod).

Cladonia fimbriata var. **tubaeformis** Mud Creek.

Cladonia gracilis var. **verticillata** Fr. Sinyaleamin Lake.

Cladonia gracilis var. **symphycarpia** Tuck. Sinyaleamin Lake, McDonald Lake, Mission Mountains. Also Missoula (Elrod).

Cladonia gracilescens (Rab.) Waimo. Rare in N. A.

Cladonia pyxidata (L.) Fr. State Station on Flathead Lake eastern side Bigfork, McDonald Lake. Also Flathead Lake and Missoula (Elrod). Sperry Glacier, Lake McDonald, Jones.

Cladonia turgida var. **conspicua** (Schaer) Nyl. Lolo Hot Springs (Elrod).

Cladonia ***rangifera*** *var.* ***sylvatica*** L. Sinyaleamin Lake, and McDonald ***Lake.*** ***Also*** *Flathead Lake (Elrod).*

Cladonia sylvatica *(L). Hoffm.* McDonald Lake in the Mission Mountains, ***Jones.***

Endocarpon miniatum Ach. Sentinel Mt.

Evernia vulpina (L.) Ach. Sentinel Mt. and Sinyaleamin Lake. Also Flathead Lake (Elrod). This is a very common and beautiful yellow lichen. Also (7911 Jones) MacDougal Peak, subalpine.

Lecanora atrata (Huds.) Ach. Flathead Lake and Rost Lake.

Lecanora cervina var. **cinerevella** Fink. Craig Mountain. Alpine.

Lecanora pallescens (L.) Ach. Missoula, growing on mosses.

Lecanora chlorophana (Wahl.) Ach. Craig Mountain. Alpine.

Lecanora punicea Ach. Rost Lake.

Lecanora rubina (Vill.) Ach. Mt. Sentinel. Also Missoula (Elrod).

Lecanora subfusca (L.) Ach. Flathead Lake and Post Creek.

Lecanora xanthophana var. **dealbata** Tuck. Craig Mountain. Alpine.

Leptogium sp. Missoula (Elrod).

Parmelia conspersa (Ehrh.) Ach. Post Creek and McDonald Lake in the Mission Mountains. Also Missoula (Elrod).

Parmelia olivacea (L.) Ach. Mt. Sentinel, St. Ignatius Mission and Post Creek.

Parmelia physodes (L.) Ach. Lolo Hot Springs (Elrod).

Parmelia physodes var. **vittata** Ach.Mt. Sentinel, Sinyaleamin Lake. Also Lolo Hot Springs (Elrod).

Parmelia physodes var. **enteromorpha** Tuck. Lolo Hot Springs (Elrod).

Parmelia saxatilis (L.) Fr. Sinyaleamin Lake. Also Flathead Lake (Elrod).

Parmelia saxatilis var. **sulcata** Nyl. O'Keefe canon and McDonald Lake. Also Lolo Hot Springs (Elrod).

Peltigera aphthosa (L.) Hoffm. Sinyaleamin Lake. Also Missoula, Lolo Hot Springs and Flathead Lake (Elrod). Also (7914 Jones) Bigfork.

Peltigera canina (L.) Hoffm. Sinyaleamin Lake, O'Keefe canon and McDonald Lake in the Mission Mountains. Also Flathead Lake and Missoula (Elrod). Alta.

Peltigera venosa (L.) Hoffm. Bigfork.

Placodium elegans (Link) De. McDonald Lake. Also Missoula and Elrod Peak (Elrod). Sperry Glacier, Jones.

Physcia stellaris (L.) Tuck. St. Ignatius Mission.

Physcia stellaris var. **aipolia** Nyl. Flathead Lake.

Rinodeina oreina (Ach.) Mass. Missoula (Elrod).

Ramalina calicaris var. **fastigiata** Flathead Lake.

Solorina crocea (L.) Sch. Sperry Glacier, Jones.

Stereocaulum alpinum Th. Fr. Sperry Glacier. Rare in North America. Jones.

Sticta pulmonaris (L.) Ach. Mud Creek and McDonald Lake in the Mission Mountains.

Theloschistes Lychnens (Nyl.) Tuck. Bigfork. Also Missoula (Elrod).

Umbelicaria hyperborea Hoffm. McDonald Lake, Mission Mts.

Umbilicaria phaea Tuck. McDonald Lake, Mission Mts.

Umbilicaria vellea (L.) Nyl. McDonald Lake, Mission Mountains. Also Lolo Hot Springs (Elrod).

Usnea barbata (L.) Fr. Mt. Sentinel and Mud Creek. Also Flathead Lake (Elrod).

Usnea barbata var. **hirta** Mt. Sentinel

Usnea cavernosa Tuck. McDonald Lake, Mission Mts.

All my species of lichens have been identified by Prof. Bruce Fink, and are given as collected by myself. Those without collectors' names, were gathered by Harris

ALGAE.

Ricciocarpus natans. Jeff's Cabin, Swan River, Jones. Identified by *Prof. Setchell.*

FUNGI.

So far as can be learned there have been but two attempts to collect the fungi on living leaves in our region. No attempt having been made so far to get the immense number growing on dead stems and the ground. A few of these have been picked up incidentally only.

Prin. T. A. Bonser now of the Spokane High School, seems to have made the first collections during his work at the Biological Station. His plants were identified by Prof. Farlow. His list covers 50 species and is embraced in this report.

During the past season I attempted to get all the Fungi on living leaves in the Flathead region. Some were missed doubtless but most of them were found. My list embraces considerably over 100 species. All my plants were identified by Chas. Peck, Esq., of Albany, New York, and Prof. J. C. Arthur of Purdue University, the latter identifications being rusts mostly.

In the descriptions of dimensions of spores "m" stands for thousands of a millimeter (in the absence of the proper sign).

Actinomena Rosae (Li.) Fr. On Rosa gymnocarpa. Dayton.

Aecidium abundans Peck. On Symphoricarpos oreophilus. Lima.

Aecidium Alleni Clint. On Shepherdia Canadensis. Wild Horse Island. Also on the same host by Bonser in Swan river valley. On Elaeagnus argenteus near Dayton. It is very rarely found on this host.

Aecidium Berberidis Pers. Wild Horse Island and Yellow Bay. On Berberis repens.

Aecidium Ranunculacearum DC. On Ranunculus glaberrimus. Lima.

Aecidium Thalictri Grev. On Thalictrum occidentale. MacDougal Peak (Bonser). Also by Jones on MacDougal Peak.

Aecidium cornutum. On Amelanchier alnifolia. Bigfork (Bonser).

Aecidium cornutum. On Amelanchier alinfolia. Bigfork (Bonser).

Agyrium elongatum (E. & E.). On dead stems of Valeriana, MacDougal Peak (Bonser).

Albugo candida (Pers.) Kuntze. On Capsella Bursa-pastoris. Bigfork.

Albugo Bliti (Biv.) Kuntze. On Amarantus blitoides. Bigfork.

Albugo. On Pentstemon confertus. Whitewater.

Ascochyta colorata Peck. On Fragaria vesca. Bigfork.

Caeoma. On Rubus Nutkana. Bigfork (Bonser).

Calyptospora columnaris (A. & S.) Kuhn. On Vaccinium Myrtillus var. microphyllum MacDougal Peak. Alpine.

Cronartium Comandrae Peck. On Comandra pallida at Wild Horse Island and Yellow Bay. Also by Elrod.

Chrysomixa Pyrolae (DC.) Rostr. On Pyrola rotundifolia. Swan river valley (Bonser).

Coleosporium Asteris. On Aster. Swan river valley (Bonser).

Coleosporium Solidaginis (Schw.) Thun. Probably includes C. Asteris. On Aster leaves at Wild Horse Island, Big Arm, Bigfork and MacDougal Peak. Also on Solidago, Swan river valley (Bonser).

Cylindrosporium simile Peck, n. sp. Maculae parvae, paucae sparsaeque vel numerosae et saepe confluentes, angulares, pallidae; acervuli in macula quavis unus multive, plerumque epiphylli, pulvinati vel plerumque nucleatae, brunnei; sporae filiformes, curvatae, continuae, hylinae, plerumque nucleatae, 40-80 x 4 m. (.0016-.0032 unciae longae, .00016 unciae latae). On living leaves of Ceanothus sanguineus. Bigfork and MacDougal Peak, Flathead Lake, Montana, August, Jones. Allied to C. Ceanothi E. & E., from which it differs in the color of the spots and in the longer continuous spores.

Cylindrosporium simile var. **Pruninum** Peck, n. var. Maculae minores, saepe coloratiores; *sporae breviores*, 30-60 m; basidia longior 15-25 m. In *foliis Pruni emarginatae. Yellow Bay* on Flathead Lake at 4000° alt. on the *slope of the Mission Mts. Some* bushes of Prunus emarginata were almost *covered with the fungus.*

Cystopus candidus (Pers.) Lev. On Cardamine hirsuta. McDonald Lake in the Mission Mountains.

Dimerosporium Collinsii (Schew.) Thum. On Amelanchier alnifolia at Bigfork. This is very abundant and seems to be affecting the fruit trees very injuriously.

Doassansia Sagittariae (West) Fisch. On Sagittaria arifolia at Swan Lake.

Doassansia Alismatis (Nees) Corn. On Alisma Plantago at Swan Lake.

Dothidea Pteridis, Phyllachora, Cryptomyces, all stages of the same fungus. On Pteris aquilina. Bigfork (Bonser). Probably the same as Uredinopsis Pteridis Diet. & Holway which I also got at the foot of MacDougal Peak on the same host.

Erineum. This was once supposed to be a fungus but now is regarded as a disease caused by mites. On Acer glabrum at Bigfork. Common.

Erysiphe Polygoni DC. On Polygonum aviculare at Wild Horse Island.

Erysiphe Polygoni var. On Lupinus at Bigfork(Bonser).

Gymnosporangium Nelsoni Arthur. On Amelanchier alnifolia at Yellow Bay.

Hydnum. The coral fungus. This was scarce but very beautiful. Polson.

Linospora Brunellae E. &. E. OnBrunella vulgaris at Swan Lake.

Marssonsia Potentillae (Desm.) Fisch. On Potentilla on Nigger Prairie Trail. Bonser.

Melampsora Medusae Thum. This is the same as Uredo Medusae (Thum.) Arthur. On Populus trichocarpa at Bigfork by Bonsor, and by myself on Populus tremuloides at Bigfork.

Melampsora Bigelovii. On Salix at Bigfork by Bonser.

Melampsoridium Betulae (Schum.) Arthur. On Betula glandulosa at MacDougal Peak. Also on B. alba at Dayton.

Melampsoropsis Pyrolae (D.C.) Arfthur. On Pyrola rotundifolia at Bigfork. This is probably the same ac Chrysomixa reported above by Bonser.

Microsphaeria Alni (Wallr.) On Vicia Americana at Bigfork by Bonser.

Microsphaeria Alni var. **ludens.** Salm. On Vicia Americana at Big Arm.

Microsphaeria Alni var. **divaricata.** On Ceanothus sangunieus at Bigfork by Bonser.

Microsphaeria diffusa C. & P. On Symphoricarpos racemosus at Bigfork. Also on the same host and locality by Bonser.

Peridermium Balsameum Peck. On Abies grandis at Swan Lake and MacDougal Peak and Yellow Bay.

Peridermium pseudo-balsameum (Holway). On Abies grandis at Bigfork by Bonser.

Peridermium ornamentale Arthur. On Abies lasiocarpa at MacDougal Peak, alpine.

Peridermium Pini. On Pinus ponderosa at Bigfork by Bonser.

Phragmidium affine Sydow. On Potentilla flabelliformis at Monida.

Phragmidium occidentale Arthur. On Rubus Nutkana at MacDougal Peak and Bigfork.

Phragmidium "tuberculatum." On Rosa at Bigfork by Bonser.

Phragmidium montivagum Arth. On Rosa gymnocarpa at Bigfork.

Phoma Lupini. On Lupinus on the MacDougal Peak trail, Bonser.

Phoma. On Arctostaphylos Uva-Ursi at Bigfork by Bonser.

Phyllosticta Angelicae Sacc. On Angelica Lyallii at Swan Lake.

Phyllosticta Arnicae Fckl. On Arnica cordifolia. Evaro.

Physoderma vagans Schroet. On Sium cicutaefolium at Bigtork.

Podosphaeria oxyacanthae (DC.) DeBary. On Prunus demissa. Ravalli.

Polythelis Thalictri (Chev.) Arthur. This is the same as Puccinia Thalictri Chev. *On Thalictrum* occidentale on slopes of MacDougal Peak.

Puccinia Absinthii (DC.) On Artemisia Ludoviciana at Polson by Bonser.

Puccinia acuminata Pp. On Cornus Canadensis on Swan river (Bonser).

Puccinia Agropyri E. &. E. On Agropyron divergens at Bigfork.

Puccinia arnicalis Peck. On Arnica cordifolia at Bigfork.

Puccinia Asteris. On Aster at Bigfork by Bonser.

Puccinia Arabis (probably the same as P. Holboellii). On Arabis on Swan river by Bonser.

Puccinia Balsamorhizae Peck. On Balsamorhiza sagittata at Wild Horse Island and Bigfork. Also on the same host at Polson by Bonser.

Puccinia Circaeae Pers. On Circaea Pacificia at Swan Lake and on Circaea alpina at Bigfork. Also on C. Pacifica on Swan river by Bonser.

Puccinia Clarkiae. On Clarkia pulchella at Bigfork (Bonser). Ronan, Jones.

Puccinia Dayi Clint. Not before reported west of the Mississippi Valley. On Steironema ciliatum at Wild Horse Island.

Puccinia Gentianae (Strauss.) Link. On Gentiana affinis at Big Arm.

Puccinia gigantospora Bubak. On Anemone multifida at Monida.

Puccinia graminis. On "grass" at Echo Lake (Bonser).

Puccinia hemispherica (Peck.) E. & E. On Lactuca pulchella at Whitefish.

Puccinia Heucherae (Schew.) Dietr. On Mitella nuda at Bigfork and MacDougal Peak, and on Tiarella unifoliata at Swan Lake. Also on Saxifraga on Swan river by Bonser.

Puccinia Hieracii (Schum.) Mart. On Hieracium Canadense at Bigfork. Also by Bonser on same host and at same locality.

Puccinia Holboellii (Hornem.) Rostr. On Arabis Holboellii at MacDougal Peak in the Upper Temperate life zone.

Puccinia intricata var. **Eriogoni.** On Eriogonum at Flathead Lake by Bonser.

Puccinia Menthae Pers. On Monarda fistulosa at Big Arm, Bigfork and Wild Horse Island, also Mentha Canadensis at Whitefish and Bigfork. Also on Mentha on Swan river by Bonser.

Puccinia melanocoides. On Dodecathon at Monida.

Puccinia mesomegala B. &. C. On Clintonia uniflora at Bigfork and MacDougal Peak. Also at Nigger Prairie on same host by Bonser.

Puccinia Physostegiae P. &. C. On Physostegia parviflora. Not heretofore known west of Indiana.

Puccinia Polygoni-amphibii. On Polygonum at Swan Lake by Bonser.

Puccinia pulverulenta Crev. On Epilobium adenocaulon at St. Ignatius Mission.

Puccinia punctata. On Galium boreale at Bigfork by Bonser.

Puccinia recedens Syd. On Senecio balsamitae at Swan Lake.

Puccinia subnitens Diet. On Distichlis spicata at the Hot Springs.

Puccinia Symphoricarpi Hark. On Symphoricarpos racemosus at MacDougal Peak and Swan Lake. Also by Bonser at Bigfork on same host.

Puccinia Troximontis Peck. On Troximon grandiflorum at Wild Horse Island.

Puccinia Violae (Schum.) DC. On Viola Canadensis at Dayton and Bigfork and on V. canina at MacDougal Peak.

Puccinia. On berberis repens at Yellow Bay and Wild Horse Island. See Aecidium.

Puccinia. On Thalictrum occidentale at MacDougal Peak. See Aecidium.

Puccinia Jonesii Peck. On Leptotaenia filicina. McDonald Lake in the Mission Mountains.

Puccinia Gayophyti Peck. On Gayophytum diffusum. Darby.

Pucciniastrum Myrtilli (Schum.) Arthur. On Vaccinium myrtilloides at Yellow Bay and Bigfork. On Vaccinium Myrtillus var. microphyllum at MacDougal Peak, where it is subalpine. Also on Vaccinium on Hall's Peak by Bonser.

Pucciniastrum pustulatum *(Pers.)* Diet. On Epilobium spictatum at Big*fork on Epilobium* adenocaulon at Bigfork. Also on Epilobium at Echo Lake *by Bonser.*

Pucciniastrum Pyrolae (Pers.) Diet. On Pyrola secunda at Yellow Bay. lso on Pyrola on Swan river by Bonser.

Pyrenophora fenestrata Peck. On Dead stems of Astragalus Bourgovii. MacDougal Peak.

Rhytisma Arbuti Phill. On Menziesia glabella at Hall's Peak, Bonser. Also by Jones on same host at MacDougal Peak and Bigfork.

Roestelia tubulata Kern n. sp.

Pycniis epiphyllis, numerosis, in greges irregulares dense confertis, maculis decoloratis insidentibus, cylindraceis. 2-3.5 mm. altis, 0-0.4 mm. diam., apice persistentes cohaerentibus; peridio firmo; cellulis peridiis fusoideo-oblongis, 17-25 m x 48-80 m, rugoso; aeciosporis globosis vel subglobosis, 18-22 m x 21-28 m; episporio castaneo-brunneo, 1.5-2.5 m. crasso, subtiliter verruculoso; poris germinantionis 6-8, sine ordine dispersis.

Habitat in foliis Crataegi Douglasii Lindley. Polson prope Flathead Lake in Montana Americae bor. 840 m. alt. Aug. 19 1908. Coll. Marcus E. Jones.

This species is characterized by its firm tube-like peridium which does not rupture at the apex but by longitudinal slits in the lower part. In its firmness and in its tendency to maintain its tubular form without becoming lacerate above it has a resemblance to Roestelia cornuta (Pers.) Fries on Sorbus. It differs from that species, however, in its more slender peridia, and in the size and surface-marking of the peridial cells. The peridial cells have a considerable resemblance to those of Roestelia globosa Farl. but it is very much unlike that species in the size of the peridia and in their manner of rupturing.

Roestelia Nelsoni Arthur. On Amelanchier alnifolia at Bigfork.

Roestelia tubulata Kern. On Crataegus allied to coccineus at Polson. On Crataegus Douglasii at Bigfork.

Roestelia cornuta Ellis. On Pyrus "Sitchensis" at Hall's Peak.

Septoria saccharina var. **occidentalis** E. &. E. On Acer glabrum at Yellow Bay, Bigfork and MacDougal Peak.

Septoria sorbi Lasch. On Pyrus sambucifolia at Yellow Bay and Bigfork. On P. "Americana" at MacDougal Peak, alpine.

Septoria salicifoliae. On Spiraea at Bigfork by Bonser.

Septoria Streptopidis Peck n. sp. Maculae subangulares, 2-8 mm. (x 1-4 mm.) latae saepe confluentes flavidae, brunneae vel rubrobunneae; perithecia amphigena, membranacea, inaequalia, atra, in macula quavis unum multave; sporae numerosae, elongatae, cylindraceae vel subfiliformes, curvatae, plurinucleatae, 30-89 x 4-5 m., ex perithecia exudantes et massam albidam formantes. On living leaves of Streptopus roseus and Prosartes trachycarpa at Yellow Bay, Swan Lake, MacDougal Peak and Bigfork.

Sphaerella Chimaphilae (E. & E.). On Chimaphila umbellata at Bigfork by Bonser.

Sphaerotheca Humuli (DC.) Burr. On Sium cicutaaefolium at Bigfork.

Triphragmium clavellum. On Aralia at Swan Lake by Bonser.

Thecaspora deformans Dur. & Mort. On Rubus Idaeus. Whitefish. On Astragalus flexuosus, Browning.

Uncinula Salicis. On Salix at Flathead Lake by Bonser.

Uredo confluens Pers. On Salix Scouleriana at Bigfork.

Uredo Lini Schum. On Linum Lewisii at Wild Horse Island.

Uredo Medusae (Thum.) Arthur. On Populus tremuloides at Bigfork .

Uredo Bigelovii (Thum.) Arth. On Vaccinium. Sperry Glacier, Alta.

Uredo Polypodii DC. On Cystopteris fragilis. Blackfoot Glacier.

Uromyces albus D. & H. On Vicia Americana at MacDougal Peak.

Uromyces Aristidae E. &. E. On Plantago Tweedyi in Deer Lodge Valley.

Uromyces Astragali (Opiz.) Schroet. On Oxytropis albiflorus at Wild

Lev. On Erythronium grandiflorum var.

Uromyces Euphorbiae C. & P. On Euphorbia serpyllifolia at St. Ignatius Mission.

Uromyces fabae (P.) Schroet. On Lathyrus "parvifolius" at Echo Lake by Bonser.

Uromyces Glycyrrhizae Magn. On Glycyrrhiza lepidota at Dayton and Wild Horse Island.

Uromyces Hedysari-obscuri. On Hedysarum flavescens at MacDougal Peak by Elrod.

Uromyces unitus Peck. On Lewisia rediviva at Missoula.

Uromyces borealis Peck. On Hedysarum sulphurescens. Como Peak, Browning, Blackfoot Glacier.

Uromyces Astragali (Opiz.) Sacc. On Astragalus alpinus. Bigfork.

Ustilago Mulfordiana. On Festuca tenella at Kalispell by Bonser.

Ustilago bromivora (Tul.) Fisch. On Bromus secalinus at Wild Horse Island. On Bromus Pumpellianus at Bigfork. On Stipa comata at Bigfork.

Ustilago. On Carex nardina. Sperry Glacier, also Carex atrofusca in the Mission Mountains.

Uredinopsis Pteridis Diet. & Holway. On Pteris aquilina at MacDougal Peak.

Uredinopsis Struthiopteridis Storm. On Aspidium Filix-Mas at MacDougal Peak. "This gives a new host for the species, and also greatly extends the range. Heretofore has been known only from Vermont and Newfoundland." Arthur.

Uropyxis sanguinea (Peck) Arthur. On Berberis repens at Yellow Bay, Wild Horse Island and MacDougal Peak.

Besides the above fungi the following were gathered but not in determinable condition.

On Prosartes rosea. Bigfork.
On Echinospermum. MacDougal Peak.
On Saxifraga punctata. McDonald Peak.
On Ribes lacustre. Bigfork.
On Parnassia fimbriata. Bigfork.
On Poterium. St. Ignatius Mission.
On Smilacina sessilifolia. Bigfork.
On Petasites. Whitefish.
On Galium boreale. Wild Horse Island.
On Leptotaenia filicina. Wild Horse Island.
On Spiraea. Bigfork.
On Hedysarum flavescens. MacDougal Peak.
On Vicia Americana. Whitefish.
On Astragalus leptaleus. Big Arm.
On Anemone nemorosa. MacDougal Peak.
On Poa alpina dead leaves. MacDougal Peak.
On Habenaria dilatata. Yellow Bay.
On Juncus Balticus. Monida.
On Juncus Mertensianus. MacDougal Peak.

LOCALITIES.

Alta, a station at the head of Bitter Root Valley.

Avalanche Basin, below Sperry Glacier.

Bigfork, the location of the University of Montana Biological Station, at the outlet of Swan River into Flathead Lake.

Blackfoot Glacier, on the north slope of Blackfoot and the south and east slopes of Jackson Mountains main range of the Rockies, the drainage into St. Mary's Lake, and the Hudson Bay drainage.

Belton, on the Great Northern railway, on the Middle Fork of Flathead River.

Bull Island, one of the chain of islands in the lower portion of Flathead Lake.

Browning, on the Great Northern railway, Blackfoot Indian Reservation.

Big Arm, the large western projection of Flathead Lake.

Como Peak, in the Bitter Root Mountains, opposite the postoffice Como.

Colville.

Darby, a town in the upper Bitter Root valley.

Dayton, postoffice at the Big Arm of Flathead Lake.

Daphnia Pond, at Bigfork, upper end of Flathead Lake.

Durant, railroad junction 15 miles east of Anaconda.

Elrod Peak, between the South and Middle Forks of Flathead River, one of a series of bald crags of yellow argillite, the waters from the north glacier flowing into Stanton Lake, from the west, forming creek which flows into the South Fork. Elevation 9,500 feet.

Evaro, station on the Northern Pacific railroad, summit or pass in the Cabinet Mountains, 16 miles from Missoula.

Echo Lake, a small lake in the wooded valley west of the Swan Range, near Bigfork.

Edwards, Mt., touching Sperry Glacier on the southwest.

Flathead Delta, upper or northern end of Flathead Lake, where Flathead River enters. The delta is formed by the old and present channels of the river.

Gunsight Pass, over the main Rockies between Gunsight and Jackson Mountains.

Gunsight Lake, between Gunsight and Jackson Mountains, on the Hudson Bay side, along the trail over Gunsight Pass.

Garrison, town on the Northern Pacific railroad, junction of Deer Lodge and Little Blackfoot Rivers.

Hot Springs, on Flathead Reservation, 35 miles west of Polson, and 25 miles from Plains, the former at the foot of Flathead Lake, the latter on the Northern Pacific railroad.

Haggin, Mount, south of Anaconda, continental divide.

Holzinger Basin, at an elevation of about 6,500 feet, along the trail from McDonald Lake to Sperry Glacier up Snyder Creek.

Jordan Lakes, two small lakes on the southwestern slope of McDonald Peak in the Mission Mountains, not far from Mission Valley proper.

Lambert Valley. A small valley at higher elevation (7,000 feet) in the Mission Mountains, on the south side of Mission Creek, back of (east of) the high unnamed peak next to Mission Valley.

Little Bitter Root, river and valley, in Flathead Indian Reservation. The valley is the old river valley which was the former outlet of Flathead Lake.

Lincoln Pass, on the trail from Lake McDonald to Gunsight, pass between Gunsight and Lincoln Peaks.

Little Matterhorn, a sharp point of rocks at foot of Sperry Glacier, jutting out from Edwards.

Lake McDonald, a few miles from Belton on the Great Northern railroad, 12 miles long and about two miles wide; not to be confused with McDonald Lake in the Mission Mountains, 80 or 90 miles further south.

Lake Louise, between Gunsight and Jackson Mountains, along Gunsight trail. Elevation about 6,000 feet.

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Lo Lo Mountains, southwest of Missoula, 9,500 feet elevation.

MacDougal Peak, in the Swan Range, over the shoulder of which the old Aeneas trail leads. Elevation 7,600 feet.

Mission Creek, in the Mission Mountains, heading in immense snowfields, flowing westward past St. Ignatius, emptying into the Pend d'Oreille River.

McDonald Peak, Mission Mountains, elevation 10,100 feet.

Monida, on the summit between Montana and Idaho, on the O. R. and N. railway.

Mud Creek, heading in the Mission Mountains, flowing westward across Mission Valley in Flathead Indian Reservation.

Nigger Prairie, an opening in the woods east of Bigfork, some new mines.

O'Keefe Canyon, about eight miles northwest of Missoula.

Polson, a town at the foot of Flathead Lake.

Polson Swamp, near Polson.

Ravalli, on the Northern Pacific railroad, Flathead Indian Reservation, 37 miles from Missoula.

Ronan, town on Flathead Reservation, in Mission Valley.

Rost Lake, a small lake a mile in diameter, in the timber at the foot of MacDougal Peak, Swan Range, Flathead Valley.

Ryan's Lake, on the slopes of Mt. Powell, Deer Lodge valley.

Rexford, a station on the Great Northern near the Canadian line, west of Whitefish.

Rim, the, rock cliff at the end of trail up Snyder Creek, at the southern edge of ice of Sperry Glacier.

Sperry Glacier, resting on the western slope of the main Rockies in a depression between Gunsight and Edwards Peaks, reached by trail from Lake McDonald either from the south side, easily, or with more difficulty by trail up Avalanche Basin.

Silloway Peak, in the Swan Range, a few miles south and a little east of MacDougal Peak, with triple summit, the highest 7,600 feet.

Swan Lake, between Mission and Swan Ranges, twelve miles long, an expansion of Swan River.

St. Ignatius, on Flathead Reservation, in Mission Valley.

Stanton Lake, three miles west of Great Northern railway, near Nyack.

Silver Bow, railway junction near Butte.

Somers, town on the northwest corner Flathead Lake.

Schultze's Cabin, a point on the Aeneas trail from Flathead Lake across Swan Range, the farthest point to which wagons may be taken.

Stanton, Mt., at upper end of Lake McDonald, northwest of the lake.

Sentinel, Mt., also called University Mountain, just east of the University of Montana campus at Missoula.

Thompson Falls, a town in Western Montana, near the state line, on the Northern Pacific railroad.

Trail Creek, a creek on the eastern face of the Swan Range, just north of MacDougal Peak, flowing into the South Fork of Flathead River..

Wild Horse Island, large island in the western or Big Arm of Flathead Lake.

Whitefish, on the Great Northern railroad, near Kalispell.

Whitewater.

Yellow Bay, on the eastern side of Flathead Lake, midway.

ADDENDA.

Since the preceding was set in type the following notes on species and descriptions of new species have been prepared, and are inserted.

The following notes may help to clear up the relationships of two sedges in our region. William Boott first separated one species and Bailey the other. Boott in his description of C. luzulaefolia confounded the two species, as they grow together in the Sierras. This is shown by the names he gave to my material. Mackenzie has also tried to separate the Nevada form of ablata which verges toward C. luzulaefolia, but it is not distinct.

Common characters are Upper spikelets sessile or nearly so, not linear, the lower mostly clavate, on elongated and filiform peduncles. Perigynia green or rusty with age, slightly inflated, the lanceolate, body nearly filled by the seed, with triangular and substipitate base, and tapering into a flat triangular beak which is scabrous and papillose and deeply 2-toothed and purple-striped down the middle, the upper half empty, a little inflated, papery, strongly nerved on the sides and faintly nerved on the face, green till mature, not less than 4 mm. long, a little longer than the scale, spreading. Bracts green and leaf-like, shorter or little longer than the blade, not as long as its sheath which is light colored and with rusty ring at tip. Sheaths widening a little above. Leaves many, broad and flat, 3-9 mm. wide, shortly acuminate, yellowish, smooth, rarely more than 1-2 dm. long, gradually reduced above along the stems to bracts, the central sheaths often 1 dm. long, the upper bracteal ones barely less than 2 cm. long. Stems at base clothed with coarse leaf fibers, often 8 mm. thick, gradually tapering at tip to almost filiform, about 3 feet high and erect, few together from very shortly stoloniferous rootstacks often 1 cm. thick. Plants of dry meadows at high elevations.

Luzulaefolia W. Boott Bot. Cal. 2 250 (1880), in part. C. fissuricola Mackenzie, (Luzula-leaved Sedge.) Spikelets 2-3 mm. long, 6-9 mm. wide, the upper ones clustered and nearly sessile. Perigynia 6 mm. long and 2 mm. wide, punctate and slightly granulated above, straight, beak about half the whole, green or rusty only. Scales dark-brown with light center, scarious margin hardly any and strong midrib going to the tip or projecting as a short awn or mucro. Leaves 4-9 mm. wide, shortly acuminate, quickly reduced to scales at base of stems. Wasatch mountains, Utah, westward and northward.

Oblata Bailey. Bot. Gaz. 13 82 (1888) (oblate Sedge). Spikelets 1-2 cm. long, the sterile 7-15 mm. long and often compound, 2-8 mm. wide, sometimes fertile in the middle, mostly clavate; fertile ones club-shaped, 1-2 cm. long, 3-6 mm. wide, only the uppermost one sessile, the rest on variously elongated peduncles, dark-brown. Perigynia with beak about ⅓ the whole, smooth, about 3 mm. long, and 2 mm. wide, with recurved tip. Scales purple with light center, ovate to oblong, obtuse, ovate to oblong, with broad hyaline and white and lacerate margins and tip, the midrib not reaching the tip. Leaves about 3 mm. wide, long-acuminate, rarely at all reduced below. Rather common in the Sierras. This probably includes C. herbariorum. First published as ablata, but intended for oblata. The Utah forms referred here are better placed in luzulaefolia. Kukenthal is probably right in placing this as a variety of luzulaefolia, since the Utah and Nevada material has sharp scales and less hyaline and longer perigynia.

Two other sedges on which our field work throws much light are Montanensis and Tolmiei. They belong to the same group as those above but ward the atrata group in the flattening of the perigynia and the

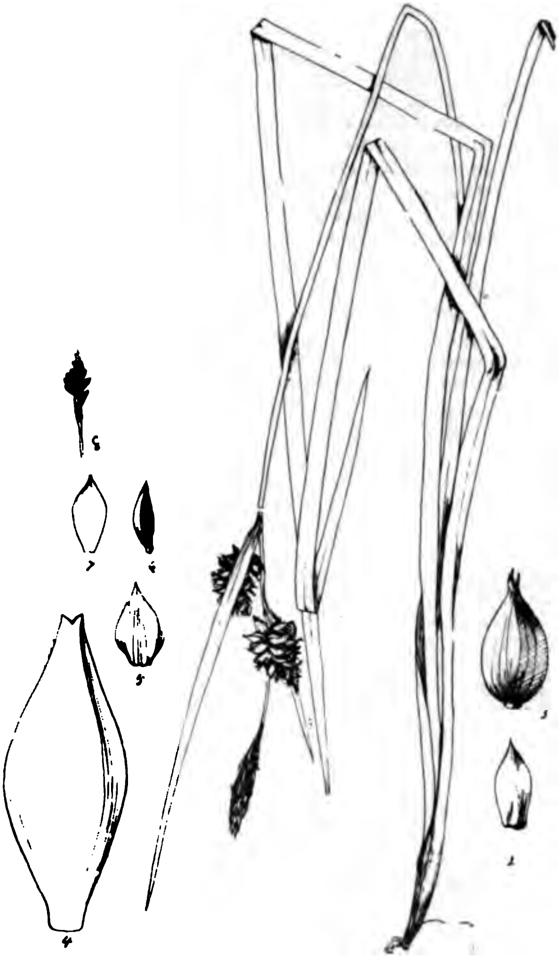
lets purple, from almost black to chestnut nate single. Perigynia oval-ovate, about 3 mm. long by 2 mm. wide, nearly flat above and triquetrous below, thin and papery, fully twice as large as the smooth seed and empty above, finely punctate when young and granulated when ripe, white when young and nearly black, at least at tip, when old, with two lateral nerves and faint green lines abruptly contracted into the face when young but appearing nerveless, spreading at about 45° angle, sessile, with cylindrical beak about twice as long as wide. Scales very dark with narrow green midrib. Bracts broad and leaf-like, nearly as wide as the leaves with subulate tip, many times longer than the very short sheaths, but not overtopping the stems. Leaves very dark-green, mostly 1-2 dm. long, quickly reduced to chestnut-colored scales below, shortly acuminate, flat and smooth, leathery without fibrillose sheaths. Stems tapering from base to slender tip, 1-1.5 feet high, growing in large clumps from shortly stoloniferous rootstocks which are densely clothed with coarse leaf fibers and appearing as if abruptly decumbent at base, leafy only on the lower third, sharply 3-angled. Plants of alpine meadows, not in wet places.

Carex Tolmiei Boott in Hook. Fl. Bor. Am. 2 224 (1840). (Tolmie's Sedge). All but the lower spikelets sessile and mostly overlapping, mostly oblong-oblanceolate,, rarely oval and then very small, the upper ones conspicuously smaller, the staminate one a little longer and wider than the rest, erect or nearly so. Scales lanceolate, acute, fully as long but a little narrower than the perigynia. Bracts with black auricles, but some of them with very short sheaths. Leaves 3-4 mm. wide. Mt. Powell and Sperry Glacier region. This has all the appearance of a hybrid between C. atrata and C. Montanensis with which it grows.

Carex Montanensis Bailey Bot. Gaz. 17 152 (1892). (Montana Sedge). All Spikelets but perhaps occasionally the uppermost fertile one on capillary and drooping peduncles from half to four times the length of the spikelets, fully developed ones about 2 cm. long and 5 mm. wide, narrowly oblong, the staminate one smaller and oblanceolate to obovate, all the fertile ones about the same length though the uppermost one when sessile is often minute and very few flowered. Scales mostly ovate and barely acute, sometimes lanceolate and acute from half to nearly as long as the perigynia, often entirely purple. Bracts with chestnut-colored auricles and the lowest with sheaths about 1 cm. long. Leaves 2.5-3 mm. wide. Stems mostly densely clustered as if caespitose but the crowns are distinctly separate. This is the most common sedge, having the habit of C. limosa, in all the alpine meadows of nothwestern Montana, and if not the same as C. atrofusca is at least very near it.

Carex aboriginum n. sp. Stems shortly stoloniferous, rigid, erect, smooth, obtusely 3-angled, finely papillose, about 3 feet high, leafy on the lower third, slender. Leaf sheaths hyaline and not fibrillose. All the leaves about half the stems, not reduced below, flat, 3 mm. wide, long-acuminate, smooth, light-green, bases light colored. Bracts green and subulate pointed, the lower 2-3 dm. long. Spikelets all peduncled, the upper fertile ones very shortly so, the single terminal and staminate one on a filiform peduncle nearly its own length and oblanceolate, about 2 cm. long and 3 mm. wide, fertile spikelets 2-3, nearly contiguous, oval, about 15 mm. long and 12 mm. wide, compactly flowered, the upper flowers spreading and the lower mostly reflexed at maturity by the crowding of the perigynia, about 25-30 flowered, fuscous with age. Perigynia about 6 mm. long and 3 mm. wide, ovate, decidedly inflated, papery, whitish and becoming fuscous when ripe. Somewhat flattened above, triquetrous but with only 2 strong lateral nerves and about 5 finer ones on the faces, finely punctate all over, which becomes almost papillose with age, half filled by the spherical seed, minutely and abruptly stipitate; beak flattened, serrate, papillose, purple, deeply notched and 2-toothed, scarcely more than a triangular prolongation of the perigynia and about as long as wide below. Scales lanceolate, acuminate purplish, with a light center, nearly as long as the perigynia but much narrower, scabrous on the midrib. Stigmas 3.

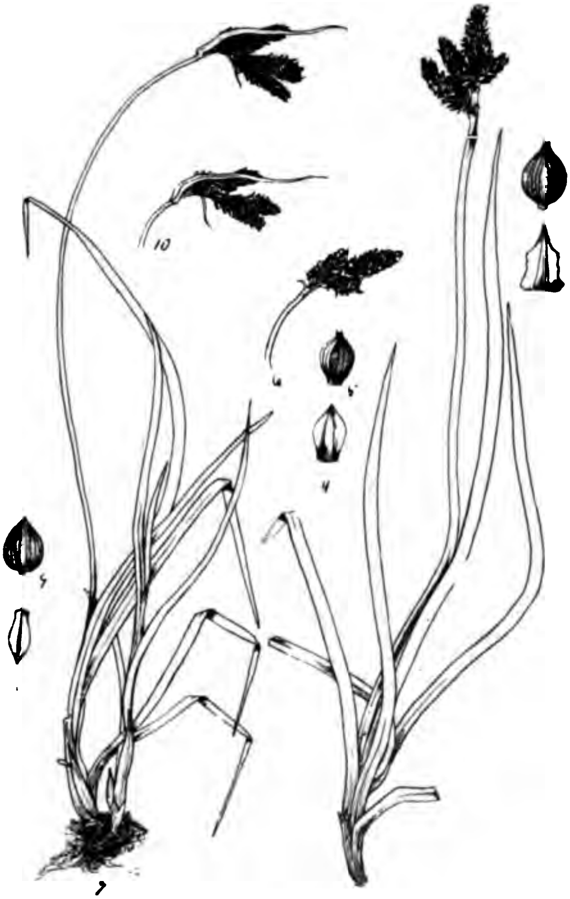
This grows on dry gumbo soil which is wet in the spring. It has the habit of C. Gmelini and is nearest related to Raynoldsii, though having fruit characters between that and ablata. Indian Valley, Southern Idaho, near Salubria, July 12, 1899. Middle Temperate life zone.



Carex aboriginum, 1, 2, 3.
Carex nardina (from Britton, x9) 4.
Carex stantonensis, 5. 6. 7. 8.

Carex Elrodi n. sp. Spikelets 3-5, the terminal one all staminate or with a few fertile flowers at tip, not over 2.5 cm. long, about 2 mm. wide, sessile, the rest fertile, sessile (the lower short-peduncled and rarely on a long and *filiform radical peduncle*), shorter, all linear except the very short subterminal ones, 3 mm. wide, chestnut-colored, contiguous, appressed, compactly *flowered.* Perigynia oval, plano-convex with sharp sides, papillose, abrutly *contracted* at base to a short stipe and at tip to a short bidentate beak not

over ¼ the whole, or reduced to a rudiment, lateral ribs prominent, faintly 1-2-ribbed on the face, mostly green, sometimes purplish above, closely appressed. 2 mm. long. Scales very broadly ovate, barely acute to cuspidate, dark-chestnut colored with broad and white hyaline edges, as long as the perigynia. Bracts very short and scale-like except the lowest which has a subulate and green tip 1-3 cm. long, sheathing with purple arricles, at least the lowest ones. Leaves all basal or nearly so, rarely 1 dm. long, 3-5 mm. **wide, feeling** smooth, but finely papillose, subulate acuminate, stiff, flat, **splitting up into** coarse chestnut-colored fibers below, sheaths slightly **fibrillose, green.** Stems obtusely angled, erect .5-1.5 ft. high, smooth, widely stoloniferous, narrow. This grows in dry meadows along with C. Parryana. **Monida,, Montana.** *Middle Temperate life zone.* This comes in the 3-stigma *group with sessile perigynia* and granular, and is related to C. Richardsoni. ***Dedicated to Prof.*** *M. J. Elrod.* Figured on P. 19 as Parryana var. Hallin.



Carex Parryana var. Statoni, 1, 2, 3.
Same, smaller specimen, 4. 5.
Carex Goodenovii var. dolia, 7, 8, 9, 10.

Carex Parryana var. **Statoni** Jones n. var. Spikelets 3-4, all sessile, congested into an ovate to oblong head, rusty, the terminal one 1.5-2 cm. long, the rest somewhat smaller to a third as long, all oblong, densely flowered, 3-6 mm. wide, appressed, the terminal one thickest. All wholly pistillate or with a few staminate at tip. Perigynia trigonous, rhomboidal obovate, the base with a substipitate spongy thickening, the tip triangularly contracted into narrow tip or beak not much longer than high, which is oblique, hyaline and notched, strongly 3-nerved with two on the sides and one on the inner face and all rounded and thickened, with 6-8 fine nerves on the outer face, granulated, 2 mm. long and 1 mm. wide and about half as thick, rusty colored. Scales ovate, acute, a little longer than the perigynia, rusty. Stigmas mostly two though frequently 3-stigma flowers are intermixed. Bracts all brown and scale-like, sheathing. Stems sharply-triangular, about 6 dm. high, erect but slender, leafy only near the base, stoloniferous, granulated but seeming smooth. Leaves 2-3 mm. wide, revolute, acuminate, about a third as long as the stems, papillose, with fibrillose sheaths, light-green. Growing in dry meadows. Deer Lodge Valley, Montana. The type collected at Ryan's ranch, Aug. 3rd, 1905. Dedicated to W. C. Staton of Anaconda. I also refer to this material got in the same valley in July, which is only 2 dm. high, with smaller spikes and scales, hardly as long as the perigynia, though having the same rusty color, with the light center and very narrow wihte edges of the type and the perigynia fully 2-3 times as thick as wide and like the type filled by the seed. This would seem to come near to C. Idahoa Bailey.

Carex Goodenovii var. **dolia** Jones n. var. Spikelets all on filiform peduncles, 2-10 mm. long, clustered in a deltoid head, 3-5, 5-15 mm. long and about 3 mm. wide, densely flowered, broadly linear, nearly black and with green perigynia, the terminal one with a few staminate flowers at the base and then clavate, or rarely at both tip and base. Perigynia broadly ovate, granulated, nerveless except the two lateral ones at the tip, plano-convex, 2 mm. long, green or flecked with purple above, sessile and with a spongy ring at base, filled by the seed, with a minute cylindrical beak not longer than high, appressed. Scales oblong, rounded and obtuse, black with light center, nearly as long as the perigynia. Bracts setaceous, green, with black auricles, the lower often 1 dm. long, sheathless. Stems filiform, 1.5-2 dm. high, nodding, obtusely angled, papillose as well as the leaves, densely caespitose, leafless except at very base. Leaves dark-green, 2-3 mm. wide, involute, shortly acuminate, about half as long as the stems, with hyaline nonfibrillose sheaths. Growing in dense mats above timber line at Sperry Glacier, Montana, in moist meadows. This evidently belongs in the C. Goodenovii group with two stigmas, and is nearest C. Goodenovii var. limnophila (Holm. as vulgaris var., Proc. Am. Acad. 17 307), but differs from that in the spongy base of the perigynia, nerveless, not sessile spikelets and narrower. It also differs fro mthe var. lipocarpa (Holm. Proc. Am. Acad. 17 308 as vulgaris var.) in the not stipitate and nerveless perigynia, granulated, clustered and short spikelets, etc. It differs still more from the var. hydrophila (Holm. l. c. as vulgaris var.) in the caespitose stems, granulated and not stipitate perigynia.

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State of Montana

Fifth Biennial Report

OF THE

State Forester

TO

Hon. Samuel V. Stewart

GOVERNOR

1917-1918

INDEPENDENT PUBLISHING CO
HELENA, MONTANA

State of Montana

Fifth Biennial Report

OF THE

State Forester

TO

Hon. Samuel V. Stewart
GOVERNOR

1917-1918

LETTER OF TRANSMITTAL.

December 1, 1918.

To His Excellency,
Honorable Samuel V. Stewart,
Governor of Montana.

Dear Sir:

In accordance with the provisions of Section 10, Chapter 147, Laws of 1909, I have the honor to transmit herewith the Fifth Biennial Report of State Forester for the years 1917 and 1918.

Also have included, through the courtesy of the National Forest Officials, of Missoula, Montana, an ably prepared contribution, entitled, "ECONOMIC USE OF THE FORESTS OF MONTANA" by Mr. JOHN F. PRESTON, Assistant District Forester, United States Forest Service; District One.

Very respectfully
JOHN C. VAN HOOK,
State Forester.

STATE FORESTRY BOARD:

SIDNEY MILLER	Register of State Lands, Chairman
CHAS. A. WHIPPLE	State Land Agent
JOHN C. VAN HOOK	State Forester

STATE FORESTER'S OFFICE:

JOHN C. VAN HOOK	State Forester
H. L. SHERLOCK	Assistant State Forester
Chas. S. Cairncross	Field Representative

TIMBER CRUISED

TIMBER CRUISED

For the two year period since my last biennial report the Department has examined, appraised and cruised, state lands, and timber, as follows:

Fiscal Year	Land—Acres	Timber—Feet
1916-1917	24,888	69,255,000
1917-1918	27,160	131,030,000
Totals	52,048	200,285,000

PERMITS ISSUED—(CLASS B).

This class of permits are issued for dead down timber, for domestic purposes, in limited quantities, free of charge:

Fiscal Year	Number Permits	Amount Cords
1916-1917	151	1,510
1917-1918	103	788
Totals	254	2,298

PERMITS ISSUED—(CLASS A)

Issued for green and dead timber, in limited quantities, for domestic purposes, and for fire killed and damaged timber, for commercial purposes, at such prices as may be designated by the State Board of Land Commissioners:

Fiscal Year	Quantity	Average Price Each
1916-1917	10,900 *Posts	1 1/3c
1916-1917	*6,363* ‡Posts	2 1/3c
1916-1917	*1,645* ‡Poles	2 1/3c

**(Dead)* *‡(Green)*

Fscal Year	Quantity		Average Price
1916-1917	1,881	cords (dead)	32c per cord
1916-1917	832	cords (green)	53c per cord
1916-1917	171,350	feet (green)	$2.22 1/2 per M
1916-1917	106,875	feet (dead)	1.50 per M
1917-1918	650,000	feet (green)	1.80 per M
1917-1918	326,330	feet (dama'd)	1.00 per M
1917-1918	358,420	feet (dama'd)	2.00 per M
1917-1918	1,179	cords (dead)	40c per cord
1917-1918	95	cords (green)	60c per cord
1917-1918	3,428	posts (green)	3 1/2c each
1917-1918	900	poles (green)	4 1/3c each
1917-1918	2,105	ties (dama'ed)	5c each

Making a total of 263 (Class A Permits) issued during the two year period, for an aggregate amount of timber, as follows:

Feet (Board Measure)	Posts	Poles	Wood Cords	Ties
1,612,975	21,591	2,545	3,987	2,105

TIE TIMBER

Live merchantable timber, advertised and sold under contract:

Fiscal Year	Number	Price
1917-1918	25,582 No. 1 ties	10c each
1917-1918	6,544 No. 2 ties	7½c each
1917-1918	4,340 No. 1 ties	12c each
Total	36,466	

MERCHANTABLE TIMBER

Live merchantable timber, advertised and sold under contract.

Fiscal Year	Feet (Board Measure)	Average Price
1916-1917	6,071,620	$3.12 per M.
1917-1918	7,236,120	3.00 per M.
1917-1918	62,828	3.50 per M.
1917-1918	4,918	3.05 per M.
1917-1918	4,000	3.75 per M.
1917-1918	1,437	4.00 per M.
Total	13,380,923	$3.062+

At the close of the fiscal year, November 30th, 1918. There is in operation, 32 Contracts for the sale of timber, in an estimated amount of 32,215,890 feet, and 111,000 ties, for the aggregate sum of $110,964.00.

This evidences an increasing demand for timber.

FINANCIAL STATEMENT.

The receipts and expenditures for the past six years are as follows:

Receipts:

1913	$ 4,688.44
1914	22,689.88
1915	20,079.62
1916	19,938.33
1917	20,922.97
1918	30,139.32

Expenditures:

1913	$ 8,693.02
1914	11,537.10
1915	13,481.08
1916	12,251.71
1917	24,614.95
1918	18,962.05

Expenditures in detail for the fiscal year ending November 30th, 1917.

General Expense:

Salary	$ 7,535.00
Travel	407.00
Office	551.20
Field	1,215.30
Total General Expense	$ 9,708.50

Fire:

Salary (Patrolmen) Weeks Law	$ 1,756.74
Transportation, Weeks Law	11.80
Regular Assessment, N. Mont. Forestry Asso.	1,275.17
Special Assessment, N. Mont. Forestry Asso.	3,825.51
Prorated Expense, *Seely Lake Fire*	702.09
Wages, Fire Fighters	4,484.04
Transportation	1,062.25

Equipment	245.20
Groceries and Supplies	1,042.63
Meals and Lodging	406.40
Telephone and Telegraph	30.90
Publicity	63.72
Total Fire Expense	$14,906.45
Total Expense for the Year 1917	24,614.95

Expenditures in detail for the fiscal year ending November 30th, 1918.

General Expense:

Salary	$ 7,337.46
Travel	593.75
Office	775.31
Field	3,439.15
Total General Expense	$12,145.67

Fire:

Salary (Patrolmen) Weeks Law	$ 2,830.31
Regular Assessment, N. Mont. Forestry Asso.	1,786.18
Cooperative Fire Expense, Flathead Indian Reservation	78.40
Prorated Share, Valley, Foster, Deep Creek, Coleman Fires	555.04
Wages (Fire Fighters	662.65
Groceries and Supplies	107.94
Transportation	333.18
Equipment	40.23
Telephone and Telegraph	24.11
Publicity (Printing, Distribution Fire Notices, etc.	398.34
Total Fire Expense	$ 6,816.38
Total Expense for the Year 1918	18,962.05

Receipts in detail for the fiscal year ending November 30th, 1917.

Timber sold for commercial purposes	$12,996.72
Timber sold for domestic purposes	741.50
Timber sold under Certificate Purchase	7,152.50
Collection made for trespass	32.25
Total Receipts for the Year 1917	$20,922.97

Receipts in detail for the fiscal year ending November 30th, 1918.

Live timber sold for commercial purposes	$18,800.42
Fire damaged timber sold for commercial purposes	1,148.42
Timber sold for domestic purposes	1,700.06
Timber sold under Certificate of Purchase	6,883.99
Unexpended Bal. Forest Cooperative Work	311.37
Collection for trespass	10.05
Collection for timber lease	15.00
Collections made for extinguishing forest fires originating on privately owned lands	1,087.93
Rebate for exchange mileage books	182.08
Total Receipts for the Year 1918	$30,139.32

As a matter of general public interest, the following information is submitted:

Twenty-five per cent of the receipts of the National Forests is devoted to the support of the Common Schools.

For the fiscal year ending June 30th, 1918, the proportion to which Montana is entitled, is as follows:

National Forests	Amount
Absaroka	$ 2,232.59
Beartooth	3,472.88
Beaverhead	7,989.60
Bitter Root	5,633.12
Blackfeet	1,182.62
Cabinet	1,129.45
Custer	3,882.66
Deer Lodge	6,655.18
Flathead	9,608.00
Gallatin	1,874.48
Helena	5,225.72
Jefferson	5,686.86
Kootenai	1,504.66
Lewis and Clark	1,324.73
Lolo	5,028.70
Madison	8,112.10
Missoula	4,626.21
Sioux	1,428.00
	$76,597.56

Distribution of Forest Reserve Fund, by Counties for the Year 1918

County	Amount
Beaverhead	$ 8,682.55
Blaine	.11
Broadwater	1,151.95
Carbon	1,615.69
Carter	1,428.00
Cascade	2 ,197.16
Chouteau	165.76
Custer	3,031.54
Deer Lodge	2,087.82
Fallon	17.38
Fergus	1,021.99
Flathead	8,277.25
Gallatin	2,892.78
Granite	3,217.31
Jefferson	3,714.16
Lewis and Clark	3,165.36
Lincoln	2,030.62
Meagher	2,465.78
Madison	6,320.60
Mineral	3,541.64
Missoula	2,882.68
Musselshell	130.64
Park	2,344.68
Phillips	157.82
Powell	3,122.91
Ravalli	5,638.87
Rosebud	906.94
Sanders	.00
Silver Bow	1,390.63
Stillwater	464.27
Sweet Grass	1,572.52
Teton	648.64
Wheatland	310.51
Total	$76,597.56

In addition to the foregoing 25 per cent distributed to the common school fund of the counties, 10 per cent of the receipts from National Forests Service is devoted to road building in the counties from which the receipts are derived.

MONTANA

Area in Square Miles	147.387
Area in Acres	94,196,480

Being the third largest state in the Union.

The whole area of the State may be roughly estimated and classified as one-third forest, one-third grazing, and one-third agricultural lands.

Eighteen (18) National Forest Reserves have been created in Montana, embracing a gross acreage of 19,400,000 and a net forest area of 16,027,000 acres.

TIMBER RESOURCES

From the most reliable data now available, Montana's present stand of living timber, of merchantable size, is estimated as 58 billion board feet, log scale.

This vast body of timber is made up of the following species in approximately the proportions given: Douglas Fir 22 per cent; Western Yellow Pine, 21 per cent; Lodgepole Pine, 20 per cent; Western Larch, 11 per cent; Englemann Spruce, 8 per cent; Cedar, 3 per cent; White Pine, 2 per cent; Miscellaneous, 13 per cent.

It is estimated that 29 per cent of this timber is privately owned, 4 per cent is held by the State, and the remaining 67 per cent is the property of the Federal Government.

Conservative estimates by the Forest Service indicate that the business of lumber manufacture in Montana represents an investment of about 22 million dollars. This great industry is second only to agriculture and mining. With the proper handling of the forest resources, the lumber business of Montana will always be one of its greatest industries.

The annual cut of timber in Montana has reached a *volume of about 400,000,000* feet.

From June 30th, 1917 to June 30th, 1918, the following cut has been reported:

	Feet
United States Forest Service	82,771,000
Indian Reservations	17,000,000
State and Private	250,000,000
Total	349,771,000

Summing up, the commercial value of the forests of the State, in all ownerships represents an aggregate community wealth of approximately $1,400,000,000.

To a state whose greatest resources is its agrcultural lands, the value of such a body of timber is incalculable. In developing the great agricultural possibilities, enormous quantities of timber are needed for building purposes.

FOREST FIRE COOPERATION

For the protection of the forests of Montana, all interests work in co-operation for the prevention and extinguishment of forest fires.

Under agreement with the State of Montana, and the United States Department of Agriculture, forest fires occurring within the boundaries of the National Forest Reserves, or within one to three miles outside of said boundaries, shall be extinguished by the National Forest Service, under the jurisdiction of the Supervisors of the several forest reserves.

The Forest Supervisor shall divide the expense of each fire, in accordance with a pro rata basis, determined by outlining the exterior boundaries of the area endangered by such fire, and computing the ratio of the acreage of lands owned or claimed by the State, the Government, and other cooperating owners, within such endangered area, making a full statement in duplicate of the total cost of such fire; shall certify the amount to be paid by the State, together with a full statement showing the total cost of the fire, and a map showing its location, the exterior boundaries of the endangered area, and the holdings of the State, the Forest Service, and cooperating owners, upon which the prorating of the expense is based, and upon verification, the amount is paid by the State.

Under the "WEEKS LAW" Agreement, between the State and the Federal Government, a fire patrol system is maintained in Montana.

The Weeks Law, by act of Congress of March the 1st, 1911, provides a fund to be expended in cooperation with the states, for the protection of forested watersheds of navigable streams.

The allotment to the State of Montana from said fund has been not to exceed $3,500, provided the State would expend a like amount. This has made available an annual sum of $7,000 for the prevention of fires by patrol work.

Under this agreement there is now being maintained in Montana, a patrol of twenty-one (21) men during the summer months. These patrolmen are placed in localities where the greatest danger from forest fires exist.

The Northern Montana Forestry Association, was organized in 1911, being a mutual association of timber owners in Flathead and Lincoln Counties. An annual assessment is levied for fire protection.

The area embraced within the bundaries of said association is 2,500,000 acres; the State of Montana being the owner of 123,861 acres. The State is a member of the association, and cooperates by paying its assessments, the State Forester being a member of the Board of Directors.

The regular assessment for the current year, 1918, is one and one-half (1½) cents per acre. To meet emergencies a special assessment may be levied. Last year, 1917, was the worst fire season of record in Montana, necessitating a total levy of four (4) cents per acre by the association for patrol and fire extinguishment.

For the present year, 1918, the association is employing a force of fifty-four (54) patrolmen.

Agencies such as the Northern Montana Forestry Association, are reducing the fire risk, and seems the best method of protecting our forests from destruction.

The affairs of the Northern Montana Forestry Association are ably managed by the Chief Fire Warden, Mr. A. E. Boorman, of Kalispell, Montana. In his seventh annual report he quotes from a recent publication by the United States Forest Service: "Forest fires in the United States have caused an average annual loss of about 70 human lives, the destruction of trees worth at the very least $25,000,000 and the loss of stock, crops, buildings and other improvements to the amount of many millions more," and adds, "This annual loss of human lives and the destruction of property valued at millions of dollars can be reduced to a minimum through well organized association efforts, if properly supported by the public."

In addition to the foregoing cooperating agencies, the State Forester, Assistant State Forester, and two Field Representatives, as Fire Wardens; every Sheriff, Under Sheriff, Deputy Sheriff, Game Warden, and Deputy Game Warden, are Ex-Officio Fire Wardens. Public spirited citizens are also appointed "Volunteer Fire Wardens," one hundred and ninety-six (196) being so appointed last year, valuable services being rendered by them.

Publicity of the great danger of forest fires is given by posting notices throughout the State; also in the theatres, lantern slides, depicting forest fire scenes are used.

The Montana Council of Defense, at a meeting held June 24th, 1918, issued an order prohibiting the setting on fire of slashings, underbrush, timber, stumps, straw, grass, weeds, or waste matter of any kind, whether located upon lands belonging to the State of Montana, the Government of the United States, Railway Rights of Way, public roads, or private property; said prohibition being for the months of June, July, August and September, of each year, during the continuance of the present war. The penalty for the violation of said Order is a fine not to exceed One Thousand Dollars, or by imprisonment in the county jail not to exceed one year, or both such fine and imprisonment.

This order has since been modified by permitting (under rules and regulations prescribed by the county councils of. defense) the burning of stubble and weeds in non-timbered areas.

Said order further provided that all campers, shall, before leaving camp, even temporarily, see to it that all camp fires are completely extinguished, and the ground around such fire saturated with water, or the ashes and coals covered with dirt to a sufficient depth to insure the complete extinguishment of the fire, and the safety of adjacent timber or grass.

All agencies interested in the preservation of the forests of Montana, have heartily endorsed this order, and the results so far observed indicate a great reduction of forest fires by reason of its prohibition for the four months' period of the dry summer season, and it can be fairly said that the people generally approve and welcome the protection afforded by the order.

The State Forester has for years urged the enactment of a law defining a closed season for brush burning, and is greatly pleased with the protection afforded by said Order No. 9, Montana Council of Defense.

FOREST FIRE FIGHTING EQUIPMENT

Telephone building, trail building, fire-breaks, and lookout stations are of first importance, providing a means of detecting, locating and promptly reaching the fire. Quick action avoids the expense and wanton waste that follows in the wake of big fires.

The fire fighting crew should be provided with shovels, mattock, axes, saws and water bags.

Upon reaching the fire, organize the crew, and select a fire boss.

Attack most fires from the rear, and work along the flanks to the head.

Clear a trail two to three feet wide around the fire and remove from it all inflammable material to the mineral soil.

Do not leave a fire until it is out.

Food for the crew should be immediately arranged for, and camp equipment when necessary.

The equipment, number of men required, method of attack and other features is governed wholly by the location of the fire, the character of the surrounding country, its slope, the direction of the prevailing wind, etc.

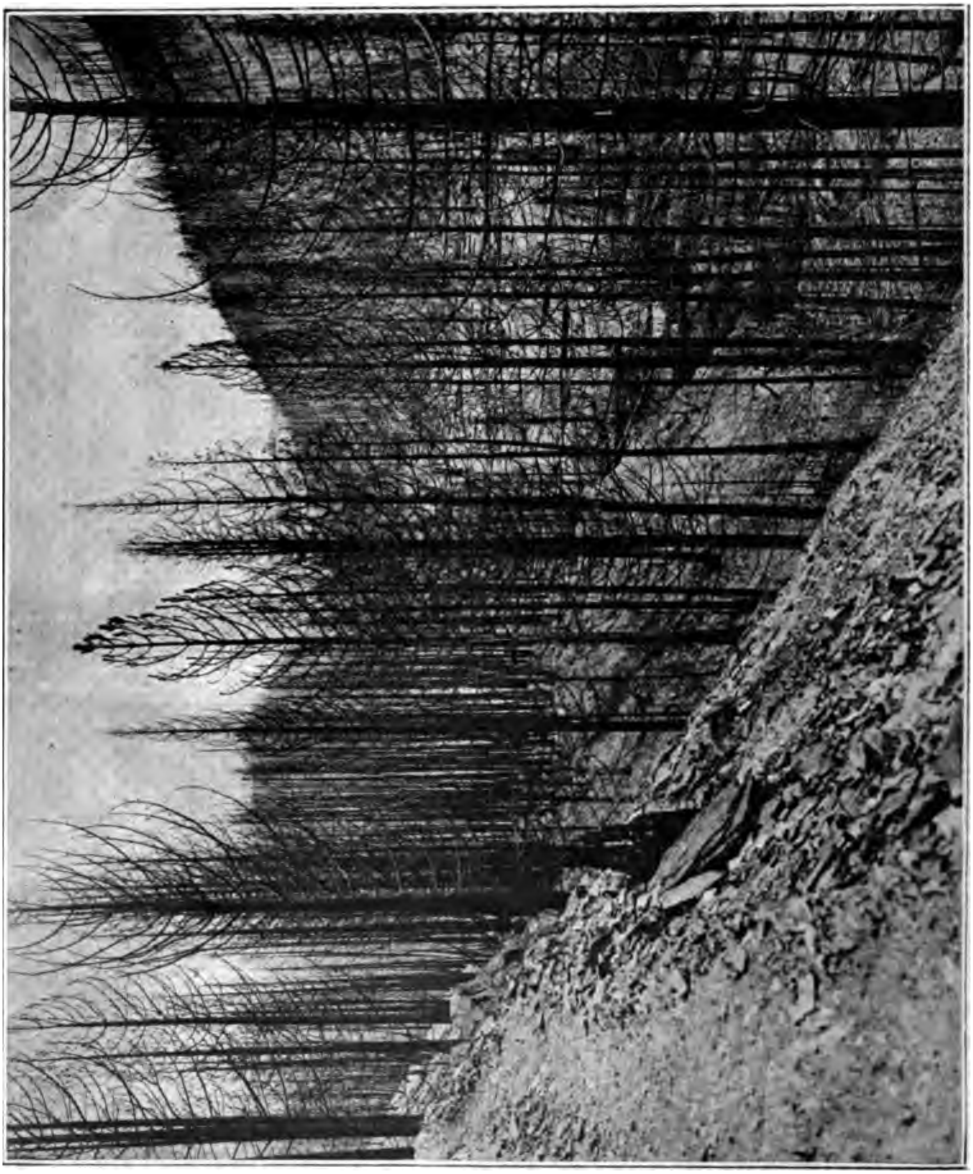
The United States Forest Service has in operation, in Montana, Two Thousand, Six Hundred (2,600) miles of telephone line, which is constantly being extended, aiding greatly in forest fire suppression.

FOREST FIRES

Owing to the extremely hot dry summer of 1917, forest fires were the most serious in the history of Montana, requiring, at great cost, the united Effort of all agencies engaged in their suppression and control; however, the system of cooperation and patrol employed, held the damage done to a minimum.

The following summary is made of the agencies reporting for the years 1917 and 1918.

Agency	No. Fires	Cost	Area Burned Acres	Damage
State of Montana	43	$ 14,906.45	7,576	$ 12,650
Northern Mont. For'try Asso.	63	35,916.89	2,474	2,000
National Forest Service	1,046	428,454.00	180,902	276,000
Totals for 1917	1,152	$479,277.34	190,952	$290,650
State of Montana	35	$ 6,816.38	9,158	$ 4,775
Northern Mont. For'try Asso.	55	14,208.71	1,931	1,000
National Forest Service	573	82,603.37	19,596	32,624
Totals for 1918	663	$103,628.46	30,685	$ 38,399



Young Yellow Pine and Red Fir Totally Killed by Fire. All Vegetation and Humus Burned Out of Soil.

PROTECTION OF PROPERTY AGAINST SLASH FIRES IN WESTERN MONTANA

Damage Caused by Uncontrolled Burning

Western Montana is distinctly a forested region. Rich agricultural valleys are found between the mountain ranges. An ever increasing population is converting the wild lands into productive farms. The non-timbered farm lands were mostly settled years ago and the homesteader of today in this region is a stump land or a timbered land farmer. The removal of the small timber, the brush, or debris left from logging is his greatest problem. Fire is the quickest, surest and cheapest known method of land clearing; but it is a dangerous weapon. If not properly controlled it sweeps far beyond the bounds of the agricultural areas and burns valuable timber lands.

The third most important industry in Montana is the lumber business. The mountains of Western Montana are clothed with valuable stands of timber, most of it on lands entirely unsuited for agriculture. The prosperity of the whole state depends upon keeping these lands productive for timber. Fire, the greatest aid to the new settler, is also the greatest menace to the forest. How can the slash fires of the settler and the irresponsible logger be controlled, without interfering with the legitimate use of this valuable aid?

During the five year period, 1913 to 1917 inclusive, for which records are available, there were 4,000 fires reported in the State of Montana. It is estimated that these fires burned over 200,000 acres of land, doing damage estimated at $480,000 and costing the State, Protective Associations, Private Owners and the U. S. Forest Service $700,000 to control. The State Forestry Department estimates that forty per cent (40%) of all fires are caused by BRUSH BURNING.

Fire Is an Important Agent in Clearing Land

There exists no more worthy or proper use of fire than burning of slash to clear land. The broadcast burning of the debris is *most essential in* order to prepare the land *for the plough. Unfortunately,* however, the very time *when such burning can* be done most successfully and

Forest Homesteads in Montana

economically is also the time of greatest danger to adjoining forest lands. During the months of June, July, August and September, the forests are extremely dry and a slash fire easily spreads and becomes a devastating forest fire destroying hundreds and thousands of dollars worth of standing timber. However, there are many periods during this time when it is perfectly safe, with a few precautions, to burn slash with little or no risk of damage to the forest wealth of the State. Recognizing the great value of fire in converting waste land into productive farms but also recognizing that the use of fire for this purpose during the dry season threatens other resources even more valuable to the people of the state, it seems obvious that some control of slash burning is imperative.

A Method of Control

Experience in this and other northwestern states points the remedy—a state law establishing a closed season during the dry period during which it will be unlawful to set fires without a permit from an officer of the state or federal government. Individuals can not be depended upon to set fires only when it is safe and to properly safeguard the burning. The great majority can be depended upon, of course, as in all other matters, to handle their private affairs with due regard to the safety and well-being of the community. There is always a minority, however, who either through ignorance, indifference or maliciousness, disregard absolutely the property rights of others. Long experience in combating forest fires is needed in order to determine under what conditions it is safe to burn slash and when the risk of spread of the flames is too great to balance the gains to the individual. The federal and state officers who would be vested with authority to issue burning permits have the experience necessary to enable them to determine when and under what conditions it is safe to burn slash. The average rancher can not be expected to know. At least experience has shown that the present system of uncontrolled privilege or license results in enormous losses of forest wealth which must be stopped.

What Other States Are Doing

Montana is falling sadly behind in progressive forest *legislation. Idaho, Washington* and Oregon have long since recognized the danger and have established closed seasons with burning only under permit. They have gone much further than that, and provided for adequate patrol of forest lands, compulsory burning of debris left from logging before and after the closed season and taken other steps which may or may not be advisable in Montana. The closed season and permit law has been thoroughly tried and found workable. It reduces the damage to a minimum. Such a law is based on the fundamental principle of cooperation between the state and the individual. The forestry organization, to get results, must help the farmers clear the land, by issuing permits when conditions are right and supervising the work to a large extent. During the closed season, at least half and often more than half the time, burning of slash can be accomplished effectively and safely, but during the remaining period no reasonable man would be willing to take the risk of destroying one of the great natural resources.

How the Permit System Works

The State Forester in cooperation with the U. S. Forest Service now maintains adequate administrative machinery to enforce the law and to make it serve both the interests of the farmers and the public welfare. Scattered over Western Montana during the dry season is a small army of forest officers—Forest Supervisors, Forest Rangers, Forest Guards, State Agents and state and federal patrolmen. One of these officers is within easy reach of every homesteader and farmer. It will be an easy matter to get in touch with a local forest officer who is authorized to issue permits. If it is safe to burn he will issue the permit and specify the precautions (if any) which must be taken to prevent the spread of the fire. There will be no delay in reaching an authorized state agent and every forest officer will have authority to take action directly. Mistakes will undoubtedly occur. Permits will be issued when it is unsafe to burn and refused at times when it appears perfectly safe, but mistakes will always occur where laws must be administered by human beings. Unquestionably, however, as already proven in other states, the net result will be far better than unregulated burning. The farm lands will be cleared in the most economical way and the damage to forest property will be reduced to a minimum. Every fire lookout in the region will be notified promptly of every permit issued and they will recognize the smoke as a legitimate smoke which will decrease the expense now incurred in fruitless "smoke chasing."

Action of State Legislature and State Council of Defense in 1918

In February, 1918, while the State Legislature was in extra session, the Governor asked for an adequate law to meet the problem, and the State Forester was instrumental in having one introduced. It was met with opposition by a few and was regarded as of minor importance by others, with the result that while a new law was enacted, it was wholly adequate to meet the need. A closed season and the permit system was not provided for in this new law. In the summer of 1918, a prolonged dry period resulted in an early and more critical fire situation than has been previously known in the fire protection history of Western Montana. With the labor shortage beginning to be felt and the necessity for reduction to a minimum of non-productive labor, the Montana Council of Defense realized the seriousness of the situation and promulgated Order No. 9, making the period July 1 to October 1 as absolute closed season for the burning of all forest refuse. To those who were directly connected with fire suppression work, the result was apparent almost at once and very gratifying. This order was a factor—one of the largest—in keeping the fire loss and expense of 1918 from reaching a figure far in excess of the actual total, but effective as it was from a forest standpoint it worked a hardship on quite a large number of farmers. On September 9, the State Council of Defense issued Order No. 14, which provided a permit system in connection with the closed season.

The Montana Council of Defense saw the threatened crisis and took action to avert it. However, this is not entirely a war problem but one in which the State is vitally interested and in which it must assume the responsibility.

State Law Proposed for Consideration of Legislature of 1919

After a careful consideration of the forest fire laws *of Washington, Oregon and* Idaho with reference to Montana conditions, the followig proposed fire law for this State has been drawn up for the consideration of the next legislative assembly. It provides for all proper use of fire, with only such safeguards as the interest of the whole people demand. It is hoped that it will secure the support of the legislature and of all patriotic citizens. It incorporates into law nothing which has not been thoroughly tried and tested in neighboring states.

This is a question for the people of the whole State to decide. Do we want to continue the present system or lack of system of unregulated use of fire and constantly endanger one of the greatest natural resources in the State? Will Montana be content to be the only state in the northwest which has not made reasonable effort to protect its forest property?

PROPOSED FOREST FIRE LAW

Section 1. In this act, unless the context or subject matter otherwise requires, the word "forester" shall mean the State Forester, or any of his subordinate officers; "warden" shall be held to mean "Fire Warden;" "ranger" to mean "Forest Ranger" or any duly appointed forest officer of the U. S. Forest Service; "rangers" shall be held to mean "Forest Rangers;" "one" shall be held to mean "person, firm or corporation" and "forest material" shall be held to mean "forest, slashing, stumpland, chopping, woodland or brushland;" "camp fire" shall be held to mean "any fire set for any purpose other than the disposal of forest material."

Section 2. All duly appointed Forest officers of the United States Forest Service, the Northern Montana Forestry Association, and the U. S. Indian Service, are hereby made ex-officio fire wardens and shall have authority to enforce and carry out the provisions of this act. Said officers are to serve without compensation from the State.

Section 3. No one shall burn any forest material within the State of Montana during the period from June 1 to September 30 inclusive of each year, which period is hereby designated as the closed season, without first obtaining permission in writing from the forester, a warden or a ranger, and afterward complying with the terms of said permit; said permit shall fix the time for setting out fires on any three consecutive days therein named, and no fire shall be set out later than ten days from date of said permit, and no such fires shall be set at a time when the wind is blowing to such an extent as to cause danger of same spreading beyond the control of the person setting said fire, and without sufficient help and tools present at time of setting and thereafter until out, to control the same, and the said fire shall be watched by the person setting the fire until the same is out; and any one violating any provisions contained in the preceding portions of this section shall, upon conviction thereof, be fined not less than twenty-five dollars ($25.00) nor more than five hundred dollars ($500.00), or be imprisoned in the county jail not exceeding thirty (30) days, or by both such fine and imprisonment.

The Forester, any of his assistants, any warden or ranger may, at his discretion, refuse, revoke or postpone the use of permits to burn when such action is clearly necessary for the safety of adjacent property.

Section 4. Any person who shall upon any land within this State set and leave any fire that shall spread or damage or destroy property of any kind not his own, shall upon conviction, be punished by a fine of not less than ten dollars ($10.00) nor more than five hundred dollars ($500.00). If such fire be set maliciously, whether on his own or on another's land, with intent to destroy property not his own, he shall be punished by a fine of not less than one hundred dollars ($100.00) nor more than one thousand dollars ($1,000.00), or imprisonment in the county jail for not less than thirty (30) days, nor more than one year, or by both such fine and imprisonment, and shall be liable for all damages in a civil suit.

During the closed season, any person who shall kindle, a camp fire on land not his own, in or dangerously near any forest material and leave same unquenched, or who shall be a party thereto, or who shall by throwing away any lighted cigar, cigarette, matches or by the use of firearms, or *in any other manner,* start a fire in forest material *not his own, and leave* same unquenched, shall upon conviction, be fined not less than ten dollars ($10.00) nor more than one hundred dollars ($100.00), or be imprisoned in the county jail not exceeding sixty (60) days.

Section 5. The forester, his assistants, wardens, rangers and all police officers are hereby empowered to make arrests without warrant of persons violating this act.

Section 6. Whenever an arrest shall have been made for a violation of any of the provisions of this act or whenever information of such violation shall have been lodged with him, the prosecuting attorney of the county in which the criminal act was committed, shall prosecute the offender or offenders, with all diligence and energy. If any prosecuting attorney shall fail to comply with the provisions of this section, he shall be guilty of a misdemeanor and shall be punished by a fine of not less than fifty dollars ($50.00) nor more than five hundred dollars ($500.00), or by imprisonment of not less than thirty (30) days, nor more than one year in the county jail. The penalties of this section shall apply to any magistrate, with proper authority, who refuses or neglects to cause the arrest and prosecution of any person or persons when complaint under oath of violation of any provisions of this act has been lodged with him.

Section 7. All fines collected under this act shall be paid into the county treasury of the county in which the offense was committed.

Section 8. All acts or parts of acts inconsistent with this act are hereby repealed.

THE WHITE-PINE BLISTER RUST

By PERLEY SPAULDING

Pathologist, Farmers Bulletin No. 742, United States Department of Agriculture, Washington, D. C.

A destructive disease of white pines known as the white-pine blister rust has been introduced from Europe and seriously threatens our white pines. It also attacks the leaves of wild and cultivated currants and gooseberries and spreads for long distances on them. Look for it on pines in May and early June on currants and gooseberries from June until the leaves are shed.

Danger to the Western States

The white-pine blister rust, however, also threatens two of the most important lumber species of the western forests, namely, sugar pine and western white pine. The mature stand of these two is estimated to be worth $240,000,000. Both of these trees have been seriously attacked by this disease in Europe. They are little grown in the Easter States where this disease is present; hence, we have absolutely no experience to show what the disease may do in this country to them. Aside from the consideration of the total valuation, these two species reproduce readily, and the prospects are good that they will form a very important part of the future forests of their regions. Any reforestation which may be done within their range is likely to consist largely of these two species.

The limber pine, which is distributed throughout the Rocky Mountain region, is known to take this disease in Europe. It, together with the two above-mentioned pines, would furnish a means for the spread of this disease over the entire Pacific coast and Rocky Mountain regions.

There can be no doubt regarding the danger from this disease if it once reached the Pacific coast or the Rocky Mountain regions, as it has been found by experiment that the wild currants and gooseberries of these sections are susceptible to the disease. Conditions in the natural forests are such that if the native forest once becomes infected there is practically no hope of controlling the disease there; hence the outlook is especially grave.

The writer has no positive evidence that the white-pine blister rust has ever been west of Indiana. Imported white pines of suspicious origin are known to have been shipped as far west as Illinois and Minnesota, but not beyond the natural range of the eastern white pine.

The western forests are so separated from the eastern forests by the Great Plains that the white-pine blister rust can reach the former only through the shipment of diseased nursery stock from the East! consequenlty, the supreme importance of preventing such shipments. All 5-needle pine stock should be grown from seed in the general locality where the trees are to be planted. Each state west of the Mississippi River should immediately enforce an absolute prohibition of the shipment of 5-needle pines or of currants or gooseberries from the section east of the Mississippi River. Seed may be shipped with entire safety, so far as this disease is concerned. The importance of such State quarantines can not be too strongly urged.

Efforts Alread Made to Control the White-Pine Blister Rust

In Europe this disease was firmly established before any eradication of plant diseases was attempted, and the only effort there exerted is merely to keep it in check. There has never been, previously, either in Europe or America, any serious attempt to eradicate a disease of trees of this type; that is, we have had no earlier experience with a disease of this sort by which to guide our attempts at controlling this one. It was in 1909 believed feasible to remove all of the diseased trees from an infected lot of pines during the course of two or three years by repeated annual inspections in the spring when the fruiting bodies of the parasite are most conspicuous on pines. The work then attempted was done with this end in view. It has become increasingly evident since that time that such annual inspections would have to be repeated for an indefinite period, as it has been found that the parasite apparently may lie dormant in an infected tree for six or more years before becoming etxernally visible. This means that inspection is not efficient. The alternative seems to be that of the total destruction of the entire lot of pines known to be infected. In the work done upto the present time, special emphasis has been given to the removal of all wild and cultivated currants and gooseberries from dangerous proximity to lots of pines known to be infected with the white-pine blister rust.

It has been found, however, in these investigations that the various State officials, who necessarily must perform this work, do not have power to destroy such currants and gooseberries as may seem necessary in order to completely control this disease. The work for this reason has been greatly hampered and in many cases has not been carried out as it should have been. Many people have not realized the seriousness of this trouble, and unanimous action could not be secured. It is absolutely necessary that the State officers have complete power to enforce such measures as are needful for the control of this disease or their work will fail, just as it has failed up to this time.

Present Status of the White-Pine Blister Rust

During the years 1909 to 1914, inclusive, the white-pine blister rust has been held well in control, considering the circumstances under which the work was carried on. In this period eleven distinct outbreaks of this disease occurred; that is, there were eleven different places where the disease spread from pines to adjacent currants or gooseberries. In these places the disease has been nearly or entirely eradicated. In 1915 the weather conditions were so favorable for the growth of the parasite that it spread very readily on currants and gooseberries for relatively long distances. In 1915 alone twelve distinct new outbreaks occurred. The areas infected vary in extent from only a few currant or gooseberry bushes up to a single area of some 400 or 500 square miles. Unless very energetic action is taken to control the disease at once, it will shortly become impossible to do so.

Need for Adequate State Laws

As above indicated, there are a number of areas where this disease has spread upon wild and cultivated currants and gooseberries. It is entirely possible to stop its further spread by the mere removal of all wild and cultivated currants and gooseberries within the infected areas. The actual carrying out of this work is not as difficult as is much of the work which is being done in the effort to hinder the spread of other diseases and pests. In carrying on this removal of currants and gooseberries, however, it is absolutely necessary that unanimous action be taken throughout the infected areas. Federal officers have no power to destroy private property in any State. This power is given solely to certain State officers, usually known as State horticultural inspectors. In most cases these State officers do not have power sufficient to compel unanimous action in such removal of currants and gooseberries. This power is one which every State should give to her proper officer at once if this work is to be efficiently done, and if such power is not thus given this serious disease of white pines is certain to escape beyond any possible control and cause irreparable damage.

Committee on the Suppression of the Pine Blister Rust in North America: The Committee is composed of four members from each State and Province where Five-Needle Pines grow, and includes Foresters, Agriculturists, Horticulturists. Pathologists, Entomologists, Lumbermen, and representatives of Agricultural Experiment Stations, Forestry and Lumbermen's Associations.

The FEDERAL HORTICULTURAL BOARD of Washington, D. C., granted the above COMMITTEE a hearing for the purpose of discussing and receiving recommendations in order to prevent the introduction of Foreign Insects and Fungus Diseases, including the PINE BLISTER RUST.

The hearing was called for May 28th, 1918, at Washington, D. C. The meeting was attended by delegates from the following States: Montana, Minnesota, Michigan, Wisconsin, Massachusetts, Maryland, Delaware, Vermont, Virginia, Illinois, Alabama, New Hampshire, North Carolina, Pennsylvania and New Jersey; other States were represented by their Congressmen; also the Nurserymen and Importers were will represented.

I had the honor of representing our State at the conference, and the discussions and matters presented impressed upon me the very serious character of the problem, particularly that of the "PINE BLISTER RUST" and the necessity of making a strong effort to keep our Western Forests free from this very destructive fungi.

The committee presented the matter to the Board on the broad grounds of "Shall the Consumers and Producers of Food and Wood be Protected from loss Caused by Foreign Insects and Fungi." At this meeting the opinion prevailed unanimously that immediate exclusion of plants from the Orient and other little explored parts of the world —except Japanese lily bulbs and sacred lily bulbs from Amoy, China, be urged at this time.

It was further agreed to urge the exclusion of all ornamental and forestry nursery stock, not heretofore mentioned, on and after July 1, 1919, and that fruit stock also be excluded as soon as economically practicable.

It being understood that for the purpose of securing new varieties the Department of Agriculture should bring in for propagation purposes such plants under such rules and regulations as it may devise.

It is believed that the Federal Horticultural Board not only has all the facts of the case but that it is cognizant of the country wide public sentiment in favor of the exclusion of plant materials which are liable to introduce injurious pests.

Its power as well as its responsibility in this matter is very great, and its decision will be awaited with general interest.

A REPORT ON THE RED BELT INJURY OF FOREST TREES OCCURRING IN THE VICINITY OF HELENA, MONTANA

Office of Forest Pathology, Missoula, Montana,*

July 24, 1918

Several reports coming from the Helena and Deer Lodge Forests and describing a peculiar injury to forest trees in these regions have been received by the Office of Forest Pathology this season. As a result of the earlier reports, Mr. Lenthall Wyman, in charge of insect control for District 1, investigated the Helena area, and found no evidence to point to insects as the cause of the trouble. He reported that the injury apparently affected the trees within an irregularly defined strip running almost parallel with the contours along the east side of the Continental Divide. This and other facts led to the belief that weather conditions may have been responsible for the damage. Later, requests were made to this office for an examination of the areas in question and Mr. E. E. Hubert was detailed for the work. His report of this work is herewith submitted.

The areas inspected are principally those in the vicinity of Helena, Montana, including the drainage areas near Park Creek, Three Mile Creek, the Marysville region, Mt. Helena and vicinity, Colorado Creek, Priest Pass region, Rimini-Red Mountain-Lee Mountain and Jericho Mountain. By observations the zone of injury was found to extend along the Northern Pacific right-of-way through Austin, Montana, up to the Continental Divide on the east slope. On the west slope it was noted from Blossburg to a point east of Elliston. From these observations it is apparent that the injury is wide-spread and occurs on both sides of the Continental Divide at least for the regions noted Throughout these regions the injury bore the characteristic banding peculiar to the red belt injury. This injury is attributable to adverse weather conditions and has been reported from District 1 by Hedgcock (1) and from District 2 by Hartley (2). Speaking of the red belt injury

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*James R. Weir in charge.

(1)
Hedgcock, G. G. Winter-killing and smelter injury in the forests of Montana.
Torreya 12:25-30. Feb., 1912.

(2)
Hartley, C. P. Notes on winter-killing of forest trees. Forest club annual.
Neb. 4:39-50. 1912.

Hedgcock (1) states that "During the past three years (1909-1911), in all, about 40,000 acres of coniferous trees have died from its effects in Montana."

The strip of affected timber is very pronounced and has the appearance of a rusty streak running parallel with the valley floor and winding in and out of the depressions along the slopes. Its width varies from a quarter to half a mile, and scattered injured trees are more frequently found below the lower demarkation of the zone. The trees on the most exposed portions of the topography were the ones most heavily affected. Slopes and ridges having Eastern, Southeastern, Southern, and Southwestern exposures were harder hit than the others. All trees within the zone were not equally affected, nor did the injury react uniformly upon the various species in the stand. In the Park Creek region very few of the trees were killed outright, but every tree in the zone bore evidence of some degree of injury. The yellow pines at first appeared to be the ones most seriously damaged, but thsi was afterward found to be otherwise. The older needles on these trees were killed, turned brown and remained attached to the tree. The youngest needles were affected in part and in som cases only the tips turned brown. New needles appeared in 1918 at the tips on many of the branches, giving the tree a peculiar appearance. In contrast to this the Douglas firs at a short distance appeared to have little or no injury, as very little browning of needles was observed at this time (July). Upon closer inspection it was found that those trees suffered considerable damage. The older needles behind the 1916 and 1917 needles were found to have been killed and had all fallen from the branches. A majority of the buds had been either killed outright or were only able to produce a very few needles, these often abortive and not able to free themselves from the bud scales. Exposed trees and parts of trees exposed above the general forest cover were noticeably more damaged than those protected by their neighbors. The zone in the Park Creek region occupied a position approximately between 5,000 and 6,000 feet elevation, and was not so distinctly outlined as the zone in the Rimini region.

A peculiar phase of the injury was noted in the case of young Douglas firs and yellow pines whose lower branches came close to the ground. The lowermost branches up to a point 2 feet from the ground were in a healthy condition and the 1918 needles had developed normally. From inquiries made and from the Weather Bureau records it was found that a 2-foot covering of snow on December 13th preceded a rapid rise in temperature, accompanied by chinook winds from the Southwest. The snow in this case apparently formed a protective layer for such branches as were imbedded in it. Many of the Douglas firs had dropped nearly all the leaves from above a point approximately 2 feet from the ground, and some of the lowermost uninjured branches bore several healthy normal cones. No cones were found on the upper portion of any of the trees on this area. Mr. Swensen, a rancher on Park Creek, stated that during the chinook period mentioned above the snow covering ranging from 2 to 3 feet in depth melted completely away within 18 to 20 hours. The species on this area found affected are Douglas fir, yellow pine, lodgepole pine, juniper and white bark pine. The latter species was but slightly affected. Increment borings made of the first three species given show that very little or no growth, according to the degree of injury, is being made by the affected trees.

This type of winter-killing shows a uniform difference in susceptibility to injury between needles of different ages. The greatest damage was found to occur to the older needles. Where the damage extended to only a portion of the needles and where only a few needles survived, these were found to be the youngest. Where parts of

needles only were killed the basal portions always remained healthy. These observations are similar to those made by Hartley (2), who says, "Assuming that the cause of death was transpiration during the sudden warm periods indicated in the weather records quoted, it might follow that the younger needles have a stronger pull on the water supply than the older ones." This is undoubtedly a correct explanation and accords with the weather data for the region covered by this report, and presented later.

The other regions visited disclosed practically the same conditions as those given for the Park Creek area. The Rimini-Red Mountain-Lee Mountain area suffered the heaviest damage. Approximately 30 per cent of the trees in the zone on this area are either dead or dying. The species affected are lodgepole pine, yellow pine, Douglas fir, Alpine fir, juniper and spruce. The lodgepole pine consists of about 80 per cent of the stand, and suffered heavily. Spruce branches in many instances were killed outright, and entirely defoliated. A peculiar effect of the injury upon the mistletoe infected trees was to kill the parasitic infection. On such trees no mistletoe plants appeared, although the trees were still alive and capable of full recovery. Nearby trees below the zone and not affected by the red belt injury and infected with mistletoe bore normal plants of the parasite.

In tracing the cause of this disorder, the U. S. Weather Bureau at Helena furnished the meteorological data for the region, and from these data a chart of the weather conditions during the cold snap and chinook period from December 11 to 15, 1917 was furnished. This period exhibited the greatest range in temperature for the entire winter, and fits in with statements made by local residents as to the probable cause of the red belt injury. The cold spell commenced on December 11th, reaching a minimum temperature of -23° at 8 A. M. on December 12th. This cold spell, with a slight rise in temperature on December 13th, continued up to noon of December 14th. A sharp rise in temperature reaching 44° above zero at 4 P. M. December 14, is recorded. This was accompanied by a warm southwest (chinook) wind which continued almost uninterrupted through December 15th. During most of this time the sky was clear, the sun adding its influence. In 56 hours a rise of 67 degrees in temperature is recorded, and on the slopes in the vicinity of the red belt zone (Park Creek) nearly all the snow covering melted in one and one-half to two days. The Helena record shows only a 6-inch reduction in the height of the snow for this period. It is possible that this particular cold spell and chinook was not alone responsible for the injury, as similar periods with smaller extreme temperatures followed during the winter. The injury may be cumulative and due to the effects of all of these periods.

The outstanding peculiarity of the injury is the limited area in which it occurs. Checking the observations made during the investigation of the areas it is found that near the heads of streams tributary to the main and larger valleys the band is found between 6,000 and 7,000 feet. Where the injury occurs on the slopes near the main valleys the band is found at a lower elevation, between 5,000 and 6,000 feet. Apparently the zone runs parallel with the general level of the valley floor.

Apparently, the red belt injury is caused by excessive transpiration of the needles during the period when the chinook winds are blowing. Usually these winds are preceded by a cold spell where the temparature drops below zero, and the ground, the roots and the entire tree are frozen. A sharp rise in temperature, accompanied by warm drying winds and sunshine, rapidly thaws the needles, causes excessive loss of water—which, due to the frozen condition of most of the tree can not be immediately replaced—and eventually the needles or parts of needles most seriously affected, turn brown or red and die. Discussing winter-killing, Hartig (3) states "In my opinion these phenomena can only be explained by the circumstances that repeated thawing and accelerated transpiration are induced in the leaves by the direct action of the sun during the bright wintry weather * * *, or by the warm *south winds, as the* case may be, and that the *leaves wither because they* are unable to obtain any water

(3)

Hartig, R. Text book of the diseases of trees.
English edition. Pg. 290. 1894

from the stems which have been frozen under the influence of long-continued and severe cold."

Mr. J. F. Preston's report of March 5, 1910, on the effects of weather on timber in Montana, gives some very good data on the 1908-1909 damage. Attention is drawn to the elevation in which the red belt occurred (5,000-5,500 feet) and the statement made that the zone ran more or less parallel with the valley floor. It is also noted that needles protected by the snow covering were uninjured.

In closing it should be stated that samples of the dead needles of yellow pine and Douglas fir submitted by Mr. Wyman, when placed in damp chambers for a period of one week developed no indications that fungi were the cause of the damage. No signs of fungus injury were to be found upon the affected needles of the various species examined in the field.

FARM AND CITY TREES

Windbreaks

Value of Windbreaks. As the farming section of Montana becomes more and more settled, the need for protection from winter winds becomes constantly more evident, and it will only be a matter of a comparatively few years before windbreaks will have their place on evrey ranch throughout this region. As the trees grow they will protect dwelling houses, barns and stock, later yielding fence posts and firewood, and finally even rough lumber for building purposes. A windbreak properly planted at this time can not fail to add to the value of the ranch, it being well-known that a farm having a windbreak on it always sells at a higher rate than the same land barren of tree growth.

Before planting is commenced the following essentials should be carefully considered:

Essentials in Planting. 1. What are the directions from which the cold winds blow? If they come from the North and West, the windbreaks should be placed in an L-shape on the north and west sides of the building; if from the South and West, place the break on these sides. In some cases it may be advisable to plant on three sides, but it is usually not desirable to completely surround the buildings with trees.

2. Never place the trees closer than 100 feet from the principal buildings, otherwise snow—which accumulates in drifts on the inner side of the break—will tend to block up the yard. If feasible, the windbreak may be 200 or even 300 feet from the buildings, and still afford ample shelter.

3. In order to have a windbreak which will effectually stop the wind, it should not be less than 40 feet in width, and may be advantageously as wide as 100 feet. The wider it is (within limits) the greater the protective value. Its length will depend on the number of buildings to be protected, the ordinary length of a windbreak being 300 to 500 feet.

4. Plow the area on which the trees are to be planted, and allow it to lie fallow or planted to a cultivated crop for one year. This is absolutely essential under conditions prevailing *in Eastern Montana.* Plant the trees the spring *after plowing, as soon as native* vegetation starts.

QUALITIES AND USES OF THE MORE IMPORTANT MONTANA WOODS

Western Pine (pinus ponderosa) is the chief lumber producing tree of Montana. The wood is light and resinous, the grain fine but often twisted, and the growth variable. It is not especially durable when in contact with the soil, lasting on the average about five or six years. Forest Service strength tests made of small clear specimens cut from trees collected in Montana gave a modulus of rupture of 4950 pounds per square inch and crushing strength of 2370 pounds per square inch.

The tree produces an average of about 13 per cent select grades, 12 per cent shop lumber and 75 per cent common grades. The wood is very extensively used in the mines at Bute and has a large variety of other uses, ranging from the coarsest construction to the high finished product. A large part of the total amount produced in Montana is consumed within the State, but quite an amount is also shipped out.

Western Larch (larix occidentalis) produces very nearly as much lumber in Montana as does Western pine. The wood is heavy, of fine growth, but is not very durable when placed in conditions subjecting it to decay. Forest Service strength tests of small clear specimens cut from trees collected in Washington gave a modulus of rupture of 7250 pounds per square inch, and a crushing strength of 3700 pounds per square inch. The tree does not produce much select lumber, 92 per cent going into the common grades and eight per cent into the select. The wood is used to quite an extent by the Butte mines and also for general building and construction purposes, for ties and for paving blocks. A considerable quantity is shipped out of the State to the prairie states of the Middle West.

Douglas Fir (pseudotsuga taxifolia) is one of the smaller lumbering producing trees of Montana. The wood is considerably lighter than larch but heavier than the Western pine in the dry condition. The fir grown in Montana is rather knotty and course grained, but is slightly more durable in contact with the soil than either larch or pine. Forest Service strength tests of small clear specimens cut from trees collected in Wyoming gave a modulus of rupture of

6340 pounds per square inch, and a crushing strength of 2920 pounds per square inch. The tree cuts out a very small percentage of selects, 98 per cent going to common lumber and only 2 per cent in the select grades. In Montana, fir and larch are graded and sold together owing to the very small percentage of selects in each of these species. The wood is used in the Butte mines and for general rough construction purposes and ties. Most of the output is consumed within the State.

Lodgepole Pine (pinus contorta) is one of the minor lumber producing species of Montana. The wood is rather light, of slow growth, and not durable when placed in conditions subjecting it to decay. The Forest Service strength tests of small clear specimens cut from trees collected in Wyoming gave a modulus of rupture of 5170 pounds per square inch, and a crushing strength of 2400 pounds per square inch. Only a small percentage is manufactured into lumber and if so manufactured yields mostly common lumber, only 7 per cent going into the selects, while 93 per cent goes into common grades.

This wood is the chief source of stulls, lagging and converter poles for the Butte mines where enormous quantities are consumed annually. It is also used for ties and fuel and to a slight extent for fence posts and telephone poles. Practically the whole output is consumed within the State.

PROPOSED TIMBER LAND EXCHANGE

AN AGREEMENT was made and entered into the 23rd day of December, A. D. 1912, between the Department of Agriculture, of the United States, and the STATE OF MONTANA, looking toward a settlement and adjustment of all matters relative to the unsurveyed school lands within the National Forests in the State of Montana: This agreement provides that all unsurveyed school sections included within the boundaries of the National Forests shall be relinquished by the State and that said unsurveyed school sections be used as a basis for the selection by the State in lieu thereof other lands equivalent in acreage and value, in one or more compact bodies, lying along and within the boundaries of the National Forests, in such psition that when eliminated therefrom all will lie outside boundaries.

In pursuance of said agreement the State and National Forest Service caused to be examined and cruised a great many of said unsurveyed school sections, and tentatively selected two areas, one located in the Stillwater and Whitefish Districts, comprising 69,180 acres, and one in the Swan River Valley of 37,180 acres, a total of 106,360 acres, being in Flathead and Lincoln Counties.

Lists have been prepared and approved, equalizing as near as possible, acreage and timber value, both the tracts to be relinquished and the areas selected.

Under date of November 27th, 1918, the President of the United States of America, WOODROW WILSON, under and in conformity with said agreement of December 23rd, 1912, duly issued a Proclamation excluding the said selected areas from the National Forests, and granting the State ninety days from the date of the Proclamation within which to file its selections for all surveyed lands eliminated, and ninety days from the approval of the official plat of survey of any unsurveyed lands embraced within the areas excluded.

In conjunction with the State Board of Land Commissioners, action will be immediately taken to comply with the terms of the Proclamation.

The early consummation of this timber land exchanged affords this Department very much satisfaction. It will give the State compact and very valuable timber tracts making their preservation and administration more economical and satisfactory. And it is to be hoped the area may be further enlarged by selections based on other isolated school sections.

ECONOMIC USE OF THE FORESTS OF MONTANA*

By John F. Preston, Assistant District Forester, United States Forest Service. District One.

INTRODUCTION

The value of forests as a national asset and the importance of their preservation and development has been very strongly brought to the attention of the world during the great war. To the far-sighted and forward-looking forest policy of France in no small measure is the successful termination of the world war due. Years ago France undertook to preserve, extend, and develop her forest resources. The result was that France, when the great emergency came, was ready and the cause of Democracy did not suffer for a lack of wood. The great importance of this resource can be appreciated only by those closely in touch with the military needs of the allied armies in France.

The great war brings home to us many truths, not the least of which is the necessity of making the highest use of timber resources, not for the present only but for all time. Mineral and forest wealth are Montana's two great natural resources. The state is already dotted with deserted mining towns and abandoned mines. Mineral wealth can not last forever and little that we can do will enlarge the quantity or extend the period of use. Forest wealth, on the other hand, if properly handled, will increase in quantity and the industries built around this resource will be permanent. Michigan, Minnesota, Wisconsin and other eastern states are dotted with sawdust piles and abandoned lumber towns and thousands of acres of land unsuited for agriculture and which formerly supported magnificent forests are now only waste lands, contributing nothing to the wealth of the states and adding to their burden of taxation.

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*This article is the work of the Office of Silviculture, United States Forest Service, at Missoula, Montana. J. W. Girard, Lenthal Wyman, and C. N. Whitney contributed largely the data used.

Reference is also made to the following list of references from which information was secured:

Dept. of Agricultural Bulletin 506—Production Lumber, Lath and Shingles in 1915 and Lumber in 1916.
J. C. NELLIS.

United States Bureau of Census Abstracts.
Montana 1917 Bulletin, State Board of Agriculture and Publicity Montana Secondary Wood Using Industries.
J. B. KNAPP.

Products Studies
U-2 Report of Consumption of Forest Production by the Butte Mines in 1914 and 1916
H. N. KNOWLTON.

U-3 Statistics of Production
U-4 Lumber Consumption in 1916.
C. N. WHITNEY.

U-2 Market Study of Gallatin Valley.
S. V. FULLAWAY, JR.

U-2 Market Study of Sun River Valley.
H. G. ADE.

Montana's forest industry is in its infancy. The population is rapidly growing and the demands for lumber are increasing. We have the choice now of saying whether we want a permanent forest industry or only sawdust piles and waste land to remind us of past prosperity. The federal government is doing a big work in preserving vast areas of mountain forest land and in regulating the cut. If allowed to continue, Montana will never be in the predicament of the Lake states, but there is a great deal to be done by the state if the full value of the forest resources is to be realized. Thirty per cent (which includes the best timber) of the forest resources are in the hands of private owners. The control and proper use of this land and timber are entirely matters for the state to undertake. It means not only some degree of control but active assistance to the industry which manufactures finished products from the forests.

The purpose of this report is to show the extent and value of the forests of the state, the lumber industry which they support, the wealth created and the people dependent on it for a livelihood, the present and future needs of the people of the state for forest products and, lastly and most important, to point out some of the things the state must do to develop and make permanent the wealth and industry which comes from well regulated forests. We must not wait until our forests are depleted with axe and fire before taking steps to insure the permanency of the forest industry. Montana should take steps now to strengthen the State Forestry organization so that it will be able not only to look after the state lands and forests but to point the way step by step to a forest policy which will insure Montana's place as a progressive, prosperous, and wholly productive state.

Forestry, like other good things, will not come about *without active effort.* The people must be educated to the *point where they understand* what it is all about and when once they do understand, there will be no question as to the action which will be taken.

In a rapidly growing state like Montana, the natural resources of the state regulate to a large extent the rate of growth. Of these assets timber, mines, and available farming land are the most important. Although the eastern half of the state is nearly devoid of forested ares, in the mountainous western part lumbering comes to its own and vies with mining and agriculture for first place in importance. As the population increases and the demands for lumber increase in proportion, the value of having an adequate supply of timber to draw upon for the natural development bound to ensue will be more and more appreciated.

Forest Wealth of the State

Distribution. In considering the location and distribution of the timber stands of Montana the state has been divided into seven regions or districts. The territory covered by each is shown graphically on a map accompanying this report.

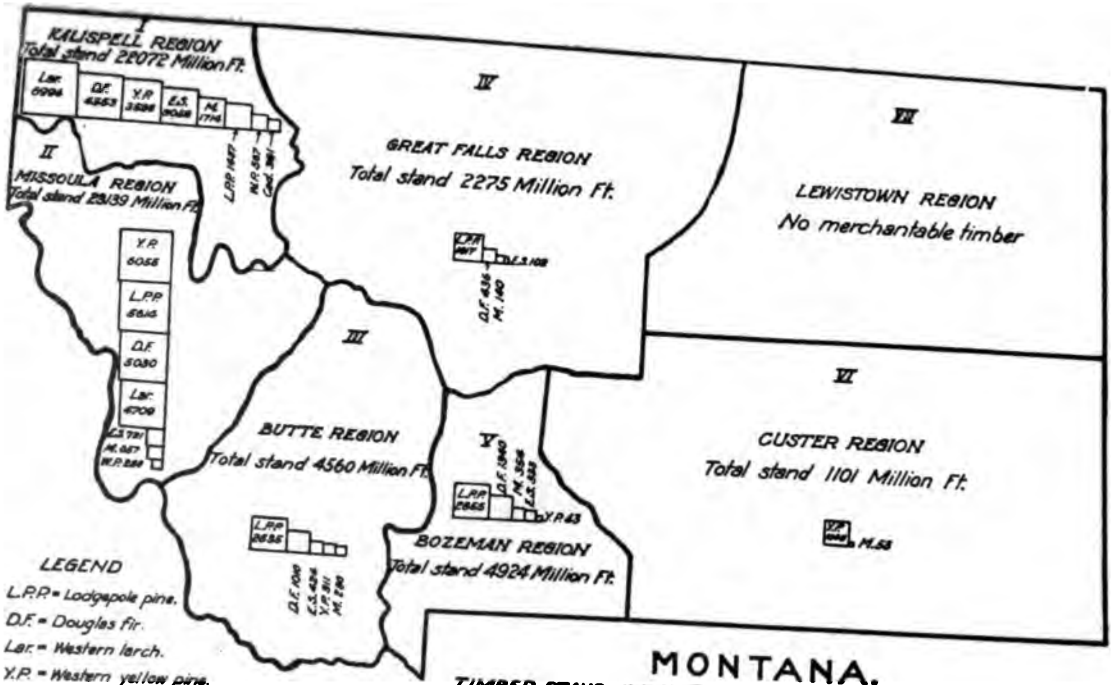
Region 1, the **Kalispell District,** includes Lincoln and Flathead Counties, the Kootenai, Flathead, and Blackfeet National Forests and Glacier National Park, together with included or closely adjacent forested land.

Region II comprises all the territory tributary to Missoula and is designated, for convenience, as the **Missoula District.** The Cabinet, Missoula, Lolo and Bitterroot Forests and the Flathead Indian Reservation are in this region. It includes Missoula, Ravalli, Sanders, Mineral, and a part of Granite and Powell Counties.

Region III is the **Butte District.** It takes in the Deerlodge, Beaverhead, Helena, and Madison Forests and all the territory which may be considered tributary to the cities of Butte and Helena.

Region IV, or the **Great Falls District,** occupies the north central part of the state, east of the Continental Divide. The Lewis and Clark, and Jefferson Forests and the Blackfeet and Fort Belknap Indian Reservations are included.

Region V is known as the **Bozeman** region as all the forested area tributary to that city falls into this district.



LEGEND

L.P.P. = Lodgepole pine.
D.F. = Douglas fir.
Lar. = Western larch.
Y.P. = Western yellow pine.
E.S. = Engelmann spruce.
W.P. = Western white pine.
Ced. = Western cedar.
M. = Miscellaneous.

MONTANA.

TIMBER STAND. All classes of ownership. (Exclusive of protection forest.)
Total stand by Species and Regions.
~in~
Million feet board measure.
March - 1918.

The Gallatin, Absaroka and Beartooth Forests are within the exterior boundaries of the Bozeman region.

Region VI takes in the southeastern corner of the state and is called the **Custer** region. The Sioux and Custer National Forests and the Crow and Tongue River Indian Reservations are the only large timbered areas included.

Region VII, the so-called **Lewistown** region, constitutes the northeastern corner of the state and contains practically no timber.

The heaviest stands lie to the west of the Continental Divide in the Kalispell and Missoula Districts; four-fifths of all the timber of the state is in these two regions. The eastern slope of the Rockies and outlying ranges included in the Great Falls, Butte, and Bozeman regions have a lighter stand and the trees are for the most part shorter, not yielding as high a percentage of lumber of the better grades as the stands farther west.

The altitudinal distribution of the forests ranges from 1800 feet (the lowest elevation in the state) on the west slope to between 10,000 and 11,000 feet, which represents about the upper limits of the growth in Montana, commonly known as "timber line."

East of the Rockies, because of the decreased rainfall, the lower limit of the timber rarely goes below 3,500 feet; 14 inches of rain are apparently necessary for tree growth at this altitude under the usual conditions of wind and topography. The elevation at which subalpine and protection forests occur of course varies greatly with the aspect and degree of slope.

Kinds of Trees:

The timber stand is composed of the following commercial species:

Lodgepole pine	**Pinus contorta**
Western yellow pine	**Pinus ponderosa**
Western white pine	**Pinus monticola**
Douglas fir	**Pseudotsuga taxifolia**
Western larch	**Larix occidentalis**
Englemann spruce	**Picea engelmanni**
Western hemlock	**Tsuga heterophylla**
Western red cedar	**Juniperus occidentalis**

In addition there are present the following subalpine specie or species of inconsiderable importance; Alpine fir **(Abies Lasiocarpa)**, limber pine **(Pinus flexilis)**, and white bark pine **(Pinus albicaulis)**, besides several species of junipers and a few broad-leaf trees such as ash, cottonwood, and birch.

Larch and western white pine are confined to and reach their optimum development in the Kalispell and Missoula regions and adjacent parts of Idaho; lodgepole pine finds its optimum habitat in the Butte region; yellow pine, Douglas fir, and spruce are found in nearly all parts of the state.

Timber Estimates:

As may be seen in Table I, the stand on the permanent productive commercial timber land for the state is about 58 billion feet. The figures submitted in this report do not include the timber on land suitable for agriculture when the timber is removed and the land cleared. For that reason the estimates are considerably lower in some instances than would be the case if the timber on the possible agricultural land was included. This is particularly true of the Kalispell region which contains the largest areas of agricultural timbered lands in the state.

Lodgepole pine, with a little more than 14 million feet, comprises 24 per cent of the total stand. The complete list is as follows:

TABLE I.

Rough Estimate of Volume by Species in Million Feet (Board Measure)

REGION	OWNERSHIP	Yellow Pine	White Pine	Douglas Fir	Englemann Spruce	Larch	Lodgepole Pine	Cedar	White Fir	Hemlock	Miscellaneous	All Species
I KALISPELL	Forest Service	692	396	2,292	1,941	3,315	753	121	....	....	1,445	10,955
	National Park	140	40	340	160	420	520	20	....	....	60	1,700
	Public Domain	....	....	5	5	8	....	....	....	....	6	24
	Total Federal	832	436	2,637	2,106	3,743	1,273	141	....	....	1,511	12,679
	State	206	105	316	210	251	214	....	3	....	195	1,500
	Private	2,560	26	1,400	742	3,000	0	160	....	....	5	7,893
	Total	3,598	567	4,353	3,058	6,994	1,487	301	3	....	1,711	22,072
II MISSOULA	Forest Service	2,295	170	2,552	531	1,051	5,376	44	16	46	365	12,446
	Indian	1,074	....	358	....	358	....	....	....	....	....	1,790
	Total Federal	3,369	170	2,910	531	1,409	5,376	44	16	46	365	14,236
	State	116	30	160	40	200	206	21	27	....	....	800
	Private	2,570	88	1,960	150	3,100	32	....	53	55	95	8,103
	Total	6,055	288	5,030	721	4,709	5,614	65	96	101	460	23,139
III BUTTE	Forest Service	27	....	816	399	....	2,510	....	....	....	276	4,028
	State and Private	284	....	194	25	....	25	....	4	....	....	532
	Total	311	....	1,010	424	....	2,535	....	4	....	276	4,560

IV GREAT FALLS	Forest Service	42	....	371	86	....	1,428	....	....	....	31	1,958
	Indian	35	....	24	8	....	47	....	....	....	4	118
	Public Domain	....	....	1	....	....	2	....	....	....	....	3
	Total Federal	77	....	396	94	....	1,477	....	....	....	35	2,079
	State and Private	5	....	40	8	....	140	....	....	....	3	196
	Total	82	....	436	102	....	1,617	....	....	....	38	2,275
V BOZEMAN	Forest Service	....	....	1,057	261	....	2,278	....	7	....	325	3,928
	National Park	3	....	83	22	....	177	....	....	....	21	306
	State and Private	40	....	200	50	....	400	....	....	....	....	690
	Total	43	....	1,340	333	....	2,855	....	7	....	346	4,924
VI CUSTER	Forest Service	462	....	9	6	....	20	....	....	....	....	497
	Indian	506	....	....	7	....	2	....	....	....	2	517
	Total Federal	968	....	9	13	....	22	....	....	....	2	1,014
	State and Private	80	....	2	1	....	4	....	....	....	....	87
	Total	1,048	....	11	14	....	26	....	....	....	2	1,101
VII LEWISTOWN	NO TIMBER											
WHOLE STATE	Forest Service	3,518	566	7,097	3,224	4,366	12,365	165	....	....	2,511	33,812
	National Park	143	40	423	182	420	697	20	....	....	81	2,006
	Public Domain	....	....	6	5	8	2	....	....	....	6	27
	Indian	1,615	....	382	15	358	49	....	....	....	6	2,425
	Total Federal	5,276	606	7,908	3,425	5,152	13,113	185	....	....	2,604	38,270
	State	322	135	476	250	451	420	21	....	....	225	2,300
	Private	5.539	114	3,796	976	6,100	601	160	....	....	215	17,501
	Total	11,137	855	12,180	4,652	11,703	14,134	366	....	....	3,044	58,071
	Per Cent	19	12	21	8	20	24	1	....	....	5	100

TABLE II.

(Areas in 1,000 acres; Volume in million feet, b. m.)

REGION	OWNERSHIP	Protection Forest Area	Productive Area	Mature Stand Area	Poles and Reproduction Area	Total Annual Growth Volume	Mature and Over-ture Stand Vol.	Immature Stand Volume	Total Stand Volume
I KALISPELL	Forest Service	1,245	2,549	1,622	927	199	8,232	2,723	10,955
	National Park	200	660	560	100	50	1,500	200	1,700
	Public Domain	....	7	2	5	....	16	8	24
	Total Federal	1,445	3,216	2,184	1,032	249	9,748	2,931	12,679
	State	....	208	160	48	14	1,300	200	1,500
	Private	110	1,073	645	428	83	6,000	1,893	7,893
	Total	1,555	4,497	2,989	1,508	346	17,048	5,024	22,072
II MISSOULA	Forest Service	403	2,997	1,247	1,750	178	9,446	3,000	12,446
	Indian	40	140	100	40	8	1,000	790	1,790
	Total Federal	443	3,137	1,347	1,790	186	10,446	3,790	14,236
	State	....	118	78	40	5	600	200	800
	Private	....	961	322	639	60	4,900	3,203	8,103
	Total	443	4,216	1,747	2,469	251	15,946	7,193	23,139
III BUTTE	Forest Service	703	2,538	1,075	1,463	104	2,354	1,674	4,028
	State and Private	....	93	44	49	3	340	192	532
	Total	703	2,631	1,119	1,512	107	2,694	1,866	4,560
IV GREAT FALLS	Forest Service	241	1,056	211	845	48	1,134	824	1,958
	Indian	30	69	28	41	3	81	37	118
	Public Domain	....	10	2	8	....	2	1	3
	Total Federal	271	1,135	241	894	51	1,217	862	2,079
	State and Private	....	145	50	95	4	150	46	196
	Total	271	1,280	291	989	55	1,367	908	2,275

V BOZEMAN	Forest Service	509	784	500	284	48	2,532	1,396	3,928
	National Park	28	92	43	49	4	206	100	806
	State and Private	....	168	83	85	5	425	265	690
	Total	537	1,044	626	428	57	3,163	1,761	4,924
VI CUSTER	Forest Service	68	303	253	50	4	287	210	497
	Indian	....	85	40	45	2	367	150	517
	Total Federal	68	388	293	95	6	654	360	1,014
	Private	....	70	40	30	....	60	27	87
	Total	68	458	333	125	6	714	387	1,101
VII LEWISTOWN	NO TIMBER								
WHOLE STATE	Forest Service	3,169	10,227	4,908	5,319	581	23,985	9,827	33,812
	National Park	228	752	603	149	54	1,706	300	2,006
	Public Domain	....	17	4	13	....	18	9	27
	Indian	70	294	168	126	13	1,448	977	2,425
	Total Federal	3,467	11,290	5,683	5,607	648	27,157	11,113	38,270
	State	....	326	238	88	19	1,900	400	2,300
	Private	110	2,510	1,184	1,326	155	11,875	5,626	17,501
	Total	3,577	14,126	7,105	7,021	822	40,932	17,139	58,071

1. Includes about 80,000 Acres State Land in units IV, V and VI.

Source of Information: U. S. Forest Plans
D. T. Mason's Report, Lumber Industry
Dept. Interior Commissioner Indian Affairs
S. V. Fullaway's Lincoln and Flathead Co. Report
Correspondence with Indian Agents., general information.

TABLE III.
ROUGH ESTIMATE OF VOLUME IN MILLION FEET, (BOARD MEASURE) AND PER CENT OF SPECIES BY REGIONS.

REGION		SPECIES								
		Yellow Pine	Western Pine	Douglas Fir	Englemann Spruce	Larch	Lodgepole Pine	Cedar	Miscellaneous	All Species
I KALISPELL	Vol.	3,598	567	4,353	3,058	6,994	1,487	301	1,714	22,072
	%	16	2	20	14	32	7	1	8	100
II MISSOULA	Vol.	6,055	288	5,030	731	4,709	5,614	65	657	23,139
	%	26	1	22	3	21	24	*	3	100
III BUTTE	Vol.	311	....	1,010	424	....	2,535	....	280	4,560
	%	7	....	22	9	....	56	....	6	100
IV GREAT FALLS	Vol.	82	....	436	102	....	1,617	....	38	2,275
	%	4	....	19	4	....	71	....	2	100
V BOZEMAN	Vol.	43	....	1,340	333	....	2,855	....	354	4,924
	%	1	....	27	7	....	58	....	7	100
VI CUSTER	Vol.	1,048	....	11	14	....	26	....	2	1,101
	%	96	....	1	1	....	2	....	*	100
VII LEWISTOWN	NO TIMBER									

*Less than ½%.

		Per Cent
Lodgepole pine	14,134	24
Douglas fir	12,180	21
Larch	11,703	20
Yellow pine	11,137	19
Engelmann spruce	4,652	8
White pine	855	2
Cedar	366	1
Miscellaneous	3,045	5
	58,071	100

By regions the most imortant species are:

Kalispell—larch, Douglas fir and yellow pine. and larch.

Missoula—yellow pine, lodgepole pine, Douglas fir and larch.

Butte—lodgepole and Douglas fir.

Great Falls—lodgepole.

Bozeman—lodgepole and Douglas fir.

Custer—yellow pine.

Lewistown—no timber.

Tables I, II, and III shows the estimates in detail.

Ownership

The total productive commercial timbered area is 14,126,000 acres, half of which is covered with mature timber and half, covered with reproduction and young growth. These figures are shown in Table II. In the same table it will be seen that there are 3,577,000 acres of protection forest important from an erosion and water supply standpoint. Practically all of the protection forest is owned by the federal government. It is composed largely of limber and white bark pine and alpine fir, averaging possibly 2,000 feet to the acre and making a total of 7 billion feet for the whole state. This, of course, should not be considered with the mercantable timber as it may be only lightly cut, and then only in especially favored districts because of the inaccessibility of the stands and the necessity for maintaining an almost unbroken forest cover.

The merchantable timber is separated by ownership *into five classes, as follows:*

	Per cent
Forest Service	58
National Park	4
Indian Reservations	.4
State	4
Private	30

Practically all of the lodgepole is held in federal ownership and 74 per cent of the spruce is also owned by the government and 66 per cent of the Douglas fir. About one-half of the larch is in private hands and the proportion is about the same for yellow pine.

Productive Capacity

Only very rough data is available from which to determine the annual cut permissible without injuring the forests. Much more accurate data will be required before any final answer can be given. Several different methods of figuring the yield, well known to Foresters, were used which gave results varying from 768 million feet to 2,250 million feet. The latter figure can probably be reached in practice only after years of care and development. In the present primeval conditions, without endangering either their permanence or the continuity of the cut, about 900 million feet is believed to be a conservative estimate of the allowable annual cut of forest products from Montana forests. The forests of the Kalispell and Missoula regions where all of the big sawmills are located will sustain a cut, under present conditions, of about 700 million feet. The present annual cut is less than 400 million feet. Some of the calculations by which these figures were obtained are given in footnote *.

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* The current annual growth for all species on the productive commercial timber land (exclusive of Park land and protection forest) for the whole state, as determined very roughly, is 768 million feet. By regions the figures are:

	Million Feet
Kalispell	296
Missoula	251
Butte	107
Great Falls	55
Bozeman	53
Custer	6
Lewistown	0
	768

These growth figures are probably lower than they would be were the stands in their most productive state with no overmature timber and all areas properly stocked. With the removal of the present overmature, stands the annual growth will increase as these cut-over areas will be in a better growing condition and increment will not be offset by decay, windfall, and other losses as it is to a great extent at present.

The proper lodgepole rotation (the age at which the timber is ripe for cutting) appears to be about 140 years and this figure is used in this report. For all other species 120 years is taken as the age at which saw-timber size will be reached. White pine, cedar and white fir might profitably be handed on a 100 year rotation but since these species are of relatively very small importance in Montana they are thrown into the 120 year class These are the rotations used in securing the limitation of cut for a sustained annual yield.

So many factors come in that it is very difficult, with no accurate information on site quality, acreage of stands now over-mature, and degree of stocking, to more than hazard a guess as to the possible future growth. However, using such yield tables as are applicable to this region for site quality II normal stands and applying them to the total acreage of the various types, the annual growth would be 2,250 million, but since the average stands are six-tenths normally stocked, it is estimated that the best that could be expected would be 1,350 million. The mean annual growth figures per acre used in the above computation are:

	Board Feet
White pine	275
Douglas fir	210
Spruce	200
Yellow pine	175
Larch	165
Lodgepole	110

This possible annual growth of 1,350 million obtains only when there are no over-mature stands, and when reproduction comes in immediately after logging. Loss by fire or other causes is not taken into account.

With the rather incomplete data at hand the limitation of cut figures must necessarily be only approximate. The best method of securing it seems to be to spread the cut in the present total mature timber stand over one-half the rotation since the mature stands occupy about one-half the total acreage which gives a very rough area check. "This is a well known method."

$$\frac{13,430 \text{ million}}{70 \text{ years}} = 192 \text{ million feet per year}$$

$$\frac{42,355 \text{ million}}{60 \text{ years}} = 706 \text{ million feet per year}$$

$$898 \text{ million feet per year, all species.}$$

The mature commercial lodgepole stand amounts to 13,430 million feet and all other species constitute 42,335 million feet.

Annual regulation of cut:

If it is planned to make the mature and over-mature stand last until the present pole stands reach the rotation stage, there would be 9,360 million feet of lodgepole to cut in 50 years or 187 million feet cut annually, and 28,623 million feet of all other species cut in 40 years which gives 716 million feet to cut annually. This makes a total of 903 million possible annual cut.

These figures do not take into account possible loss by fire, insects, fungi and other causes nor do they take into consideration the increment on the mature and over-mature stands for half the cutting period. These factors tend to affect each other but on the whole the 900 million feet is probably low rather than high and with proper care and management should increase materially.

A sustained annual yield of at least a billion and a quarter can reasonably be expected when the present over-mature stands have been logged.

PRODUCTION OF FOREST PRODUCTS

Number and Size of Sawmills

There were 103 sawmills in operation in the state during the year 1916, each producing an annual cut of 50,000 board feet or more. The following tabulation shows the number of different sized mills included in the above 103 miles from which complete and reliable data has been secured.

Annual Cut	No. of Mills
10,000 M or more	8
5,000 M to 10,000 M	4
1,000 M to 5,000 M	8
500 M to 1,000 M	10
50 M to 500 M	73
Total	103

In addition to these mills, there were in operation during 1916 probably from 20 to 30 mills cutting less than 50 M per year. Most of these mills are located east of the Continental Divide.

Annual Lumber Production

The best available statistics on the annual production of lumber in the state during the last ten years up to and including 1915 vary from about 337 million feet b. m. as the maximum to about 228 million feet b. m. as the minimum. The average is 312 million per year. This information is based upon data compiled from reports from operators who manufacture more than 50,000 feet b. m. per year. Small mills not included in the above figures produce probably from 500,000 feet b. m. to 3,000,000 feet b. m. per year. It would appear then that the average production of lumber during the past ten years ranges from 313 to 315 million feet b. m.

The cut for 1916 is considerably above the average for the past ten years. For the purpose of this article, however, the production of lumber for 1916 is assumed as being representative of what may be expected for a normal year in the future—for several years at least. The *total lumber* cut for 1916, based upon mill cutting 50,000 *feet b. m.* or more per year is 383,884,000 feet b. m. If *the small mills* cutting less than 50,000 feet b. m. per year are included, it is believed to be conservative to assume that the total cut for 1916 was in round numbers at least 385,000,000 feet b. m.

There are several reasons for this great increase in lumber production during 1916. These reason are as follows:

1. Stimulation in building and increase in lumber values.
2. More complete information on the physical and mechanical properties of Montana woods and the wide range of uses to which these woods are particularly adapted.
3. Better quality of manufacture.
4. More efficiently organized operations and selling methods.
5. Increased demand because of war requirements.
6. Pressure from taxation and carrying charges.
7. Agricultural development and activity in other industries requiring lumber.

The lumber production by species is as follows:

	Board Feet Measure
Yellow pine	138,206,000
Douglas fir	56,845,000
White pine	10,497,000
Larch	163,829,000
Spruce	6,790,000
Cedar	2,612,000
White fir	3,408,000
Lodgepole Pine	1,631,000
Cottonwood	66,000
Total reported	383,884,000

There was no hemlock reported, but it is known that a small amount was manufactured in the western part of the state. The total hemlock cut was probably from 2 to 3 million feet. This species was largely sold with the larch and Douglas fir.

Total Cut All Forest Products

In addition to the lumber produced, there were 25,522,000 pieces of lath and 16,266,000 shingles. Figuring that 7,000 lath is equal to 1,000 feet b. m. and 10,000 shingles is equal to 1,000 feet b. m. of lumber, the lath and shingles produced are equal in round numbers to 5,200,000 feet b. m.

The stulls, lagging, converter poles, cordwood, ties, posts and poles produced are estimated to be equivalent to approximately 204 million feet b. m.

The following table shows the total estimated amount of forest products manufactured during 1916, in terms of feet b. m.

	Feet Board Measure
Lumber	385,000,000
Stulls	75,000,000
Lagging	1,000,000
Converter poles	1,500,000
Cordwood	100,000,000
Ties (not included in lumber)	20,000,000
Posts	5,000,000
Poles, pilings, etc.	2,000,000
Shingles	1,600,000
Lath	3,640,000
Total Forest Products	594,740,000

The total figures are rounded off to 595,000,000 feet b. m.

The total cost of handling these products from stump to final place (as given in detail later) is estimated to average about $40.00 per M, which includes the freight. It is estimated that the amount of money expended in labor, freight, etc. for each thousand feet of fuel wood used is about one-fourth as much per M as for lumber. One reason for this is that a large proportion of the wood is used on ranches and is not shipped over any railroad.

The figures for the production of lumber, lath, and shingles are considered very reliable, because they are based upon authoritative data. The figures for the other Forest Products may be slightly in error for the reason that they are partly based upon estimates, but in most cases the estimates are believed to be conservative; possibly estimates of stulls may be too high.

Relation of Logging and Milling Costs to f. o. b Prices at Mill

This varies greatly for different regions, different species, and between different operators. Nothing more than general averages can be given. During the last ten years the margin between total costs from the stump to

f. o. b. cars and the selling prices has been very small. In many cases the two have been about the same and sometimes the selling price has been less than the cost of production.

Lumber manufacturers have not made 10 per cent net on their investment during the past ten years, if the cost of carrying charges on their holdings, such as protection, taxes and insurance, is charge to the annual cut. During 1917 the manufacturers probably made from 10 per cent to 20 per cent on their. investment, excepting operators who were tied up a large part of the year by strikes, shortage of labor, et cetera. Any one familiar with logging and lumbering operations, realizes that this is a very risky and hazardous business and is entitled to a higher margin, to insure a fair industrial return, than almost any other line of business.

The following tabulations show the estimated relation between manufacturing costs and the selling prices f. o. b. mill for a representative plant during 1917. This mill cuts from 15 to 22 million feet per year. It is an up-to-date band mill. The cut is about 75 per cent yellow pine. The timber was sound and the quality good.

Kind of Mill	Daily Capacity	Estimated Investment in Mill	Estimated Investment in Operating Capital, Logging equipment, etc.	Estimated Investment in Stock Carried in Yard	Total Average Profit bearing Investment
Band	60,000	$80,000	$80,000	$200,000	$360,000

The following tabulation shows an analysis of the operation and the relation between the operating costs and the f. o. b. mill selling prices.

Logging	Manufacturing Lumber Tally	Over Run, Per Cent	Manufacturing Log Scale	Stumpage	Total Cost Stump to Car Log Scale	Selling Price f. o. b. Mill, Lumber Tally	Selling Price Log Scale	Margin Per Thousand	Amount Cut	Total Margin
$11.00	$6.50	20	$7.80	$3.25	$22.05	$22.00	$26.40	$4.35	15000M	$65,250

On ths basis, and for this particular operation, the gross profit on the investment is about 18.1 per cent. Assuming that money in this region is worth at least 8 per cent, and including interest as a cost, the net profit on the investment is 10.1 per cent This does not allow anything for taxes and carrying charges on standing timber. It is believed that the average mill in Montana during 1917 did not earn more than 10 to 15 per cent on the investment, from which interest, taxes, and carrying charges on stumpage must be paid.

Freight Rates to Eastern Montana Points

The freight rate per M feet b. m. varies greatly, of course, for different species and for different kinds of material. It is estimated that the freight rate per M for all Montana lumber, from origin to destination varies from about $2.50 to $7.00 per M with an average of probably $5.00 per M. The rate per M for the material shipped in from the Coast varies from about $2.45 per M for the lightest material (cedar bevel siding) to about $10.00 per M for timbers with an estimated average of not less than $8.00 per M for all material shipped.

The freight rates per 100 pounds of lumber are uniform for all grades.

For car-load shipments the approximate rates per 100 pounds to several Montana points are as follows:

	TO				
FROM	Bozeman	Billings	Miles City	Havre	Glasgow
Missoula, Mont	12½c	20c	25c		
Eureka, Mont.				13c	21c
Sandpoint, Ida.	25½c	33c			
St. Maries, Ida.			33c		
Pacific Coast Points (Seattle, Portland)	35c	35c	35c	35c	40c

The freight per M from these different points varies considerably for different species and dfiferent classes of product. The following table gives the freight rates per M feet of lumber by producing regions to the Gallatin Valley or the Bozeman region:

Species	Producing Region	Boards	Dimension	Planks Timbers	Rustic	Shiplap	Drop Siding	Flooring	Ceiling
Coast Fir	Coast	8.75	9.28	10.15	8.40	8.75	7.00	7.00	4.90
Larch and Douglas Fir	Missoula	2.75	3.00	3.75	2.38	2.50	2.50	2.50	2.50
	St. Regis	3.63	3.96	4.95	3.14	3.30	3.30	3.30	3.30
	Idaho	5.61	6.12	7.66	4.85	5.10	5.10	5.10	5.10
Western Yellow Fir	Missoula	2.50	2.75	3.63	2.25	2.38	2.38	2.38	2.38
	St. Regis	3.30	3.63	4.79	2.97	3.14	3.14	3.14	3.14
	Idaho	5.10	5.61	7.40	4.59	4.85	4.85	4.85	4.85
Western White Pine	Missoula	2.38	2.63	3.63	2.25	2.25	2.25	2.25	2.25
	St. Regis	3.14	3.47	4.79	2.97	2.97	2.97	2.97	2.97
	Idaho	4.85	5.36	7.40	4.59	4.59	4.59	4.59	4.59

THESE RATES PER M ARE FOR AIR-DRIED LUMBER

Factors of Competition With Mills Further West

The factors which determine competition are: the cost of stumpage, cost of logging, cost of manufacturing, quality of lumber, grades, sizes, strength, durability, adaptability to certain uses, weight, freight rates, etc. If it were possible to make a detailed analysis of all the factors enumerated, it would then be possible to show diogrammatically the possibilities of each timbered locality. Theoretically, the factor which determines the economical competition with mills further West in distance, which in turn greatly affect the freight rates. This one factor, however, does not determine the limit of competition with the mills further West.

The Coast mills can log cheaper and the timber is of better quality and is better suited to certain sizes and grades. The mills in this state can compete with the Coast mills to a certain distance, for certain kinds and sizes of material.

The freight rate from Missoula, Montana, to Bozeman, Montana, is 12.5 cents per hundred pounds. From Bellingham, Washington, to Bozeman, the rate is 35 cents per hundred, or 22.5 cents per hundred more. In this case, assuming 2x4 dimension to weigh 2,400 pounds per M feet b. m., the Coast *mill shiping* to Bozeman must pay *$5.40 per M more for freight* than the mills at Missoula or *Bonner, Montana. If* there is no difference in the quality of the lumber, and the logging on the Coast is not more than $5.40 per M cheaper than the Montana logging, the Coast mills, theoretically, should not get any of the business in Bozeman for this particular class of material, provided that Montana has sufficient timber to supply all such markets within the state. There are, however, certain classes of material which probably cannot be supplied for the entire state from Montana mills because of the quality of the timber. There are more Douglas fir clears, such as flooring, ceiling and the like, used in the state than could be supplied from the Douglas fir which is cut annually within the state. It is believed that there is a big field for larch in this particular line if it is rift or vertical grain sawed and properly dried. It should be investigated, and I believe that it is financially feasible and practically possible to replace a large portion of the Coast fir clears with Montana larch.

A complete and detailed analysis of the factors affecting competition would require complete knowledge of lumber consumption, by grades and sizes; complete knowledge of logging and manufacturing costs; complete knowledge on available timber, its quality and condition and a complete diagram of freight rates. This kind of study, to be of greatest value to the producer and the consumer would necessarily cover, not only the state of Montana, but the entire United States. This should be one of the ultimate aims of the Forest Service and the State Forestry Departments. It will then be possible to formulate working plans and regulate the cut on the basis of sustained annual iyeld for all timber producing areas, but varied locally to meet demands from an economic point of view. Such a study as this would make it possible to divide the country into zones showing the following information:

1. Population and consumption of forest products.
2. Amount and quality of available timber.
3. Present source of supply.
4. Most economical source of supply.
5. Where competition should be encouraged.
6. Zone lines for different grades of material.

It would be found by a study of this kind that certain market zones would be overlapped by other zones for certain grades. If a certain zone could be most economically supplied from a certain body of timber, based upon distance and logging condtions, it might be found that the quality of timber was such that certain grades and sizes could not be produced in sufficient quantity to supply the demand. In that case, that particular zone would necessarily have to be overlapped by the zone which could most economically supply the special product.

Shipping lumber long distances has two disadvantages:

1. It reduces the manufacturer's margin, and
2. It increases the cost of the lumber to the consumer.

The two most important features in connection with the lumber industry are (1) the business should be on a sufficiently sound basis to yield a fair industrial return on the investment and (2) it should be so organized relative to competition, cooperation and distribution, that the consumer could secure lumber at the lowest practicable rate.

Market Limitations of Montana Mills and Relation to Number and Size of Mills and Accessibility of Stumpage

The market limitations of Montana mills are determined by practically the same factors as outlined under "factors of competition with mills further west." The size and quality of the timber, accessibility, logging conditions, logging costs and manufacturing costs, primarily determine the limitation of Montana mills but the amount of timber, quality of timber, logging costs, etc., in adjacent states also materially affect the limitation.

Assuming that the total cut of Montana mills for 1916 was 385 million feet b. m. of lumber, which includes the sawed ties and timbers, and that 80 per cent of the cut was sold in Montana, the total consumption from Montana mills would be 308 million feet b. m. The best information available shows that the Idaho mills sold 80,000,000 feet b. m. in Montana, the Pacific Coast mills sold 213,000,000 feet b. m. and approximately 1,000,000 feet b. m. of of hardwoods were shipped in from various eastern states. The material which was cut under free use and commercial sales up to $100 and Forest Service sales to settlers at cost, are eliminated from the above figures. On this basis the Montana mills supply only about 52 per cent of the lumber consumed in Montana. The annual growth of timber in the state is figured conservatively to be not less than 900 million feet b. m. This indicates that the state has sufficient timber to supply the present annual consumption indefinitely, and have a considerable surplus to dispose of elsewhere or in the form of other products, provided that the forest lands are protected and properly managed.

Theoretically, the Montana market should be supplied by Montana mills but there is a certain amount of white pine, cedar, and probably some Douglas fir clears and large timbers which could not be furnished by Montana mills. Without more detailed study, it is not possible to determine with any degree of accuracy what percentage of the total consumption of lumber in Montana could be most economically supplied by Montana mills, but it is roughly estimated that from 75 to 90 per cent should be so supplied.

Assuming that 75 per cent (the more conservative figure) could and should be supplied by Montana mills: this means that the cut would have to be increased from 385 million to 450 million, an increase of only 65 million. The present mill capacity of the state is ample to take care of this amount. This would mean a decrease in the amounts shipped into the state from the coast, and from Idaho of approximately 140 million feet and a decrease in the amount shipped to other markets of about 75 million feet. Of the 140 million feet decrease in shipments from points outside the state, it is reasonable to assume that 120 million would be from Coast mills and 20 millions from Idaho mills. This would represent a saving to the consumer of about $3.00 in freight on the Coast lumber and $1.00 on the Idaho lumber, or a total reduction in the price of lumber paid by the consumer of $380,000 annually, or an annual saving per capita of 76 cents.

The only way to get at the actual figures is by a comprehensive study of the demands of the consumer, *correlated with* the sizes, grades, and kinds of lumber *produced in the* state. Is it not a problem worth studying? *Are not both* producer and consumer entitled to know the facts and should not the state undertake to bring about a more satisfactory condtion of affairs?

One factor which affects the possibility of this development is the fact that owners of Pacific Coast timber and mills operate a large number of retail yards in the state and naturally they are most concerned about a market for their own stumpage. This may affect to some extent the possibility of supplying some of the markets in the eastern part of the state with native timber.

The data at hand indicates that several more small mills and a number of medium sized band mills could be profitably operated in this state. Probably the biggest field for increased business and better utilization of forest products is in the development of the pulp industry. It is believed that this state can supply at least one and possibly two good sized pulp mills indefinitely. This phase of timber development should be thoroughly investigated.

Distribution of the Total Cut

There is not sufficient data available to accurately show the distribution of the entire cut. Reliable data is available for about 359 million feet b. m. This is about 85 per cent of the total cut and it is believed to be representative for the distribution of the entire cut. The amount or percentage of the entire cut sold in Montana does not check with figures which have previously been worked up because more complete data has been obtained since these figures were compiled. The following tabulation shows where the lumber was sold, the amount, and the percentage each amount is of the total sold, also the total cut for all mills included in the tabulation, the amount of stock on hand and the percentage this is of the total cut.

Distribution of Montana Lumber, 1916 Cut

WHERE SOLD	Amount M	Approximate Per Cent of	Amount Cut M	Amount in Yard M	Per Cent of Total Cut in Yard
Montana	288,940	80.50			
Nevada, Utah, Oregon, Colorado, Wyoming and New Mexico	4,803	1.34			
North Dakota, South Dakota, Kansas and Oklahoma	17,596	4.92			
Minnesota, Wisconsin, Iowa, Illinois, Missouri, Michigan and Indiana	23.725	6.54			
Atlantic States	8,282	2.30			
Canada	618	0.20			
Other States	15,101	4.20			
Totals	359,065	100.	377,912	191,599	51

The above figures indicate that, when the lumber market is good and the demand is above normal, not more than 50 to 60 per cent of the annual cut is carried in stock. If the stock on hand for large mills is averaged over a period of five to ten years, it usually amounts to from 60 to 80 per cent of the total annual production, but as small mills usually sell a large portion of their cut in the rough, much less lumber is carried in stock by these mills. It is believed that for the entire state 60 per cent of the annual production of lumber would be a safe figure to use for normal conditions, including all types and sizes of mills in the state. In order, however, to be on the safe side in figuring investment in lumber, 70 per cent of the annual cut is usually assumed to be a conservative figure.

Approximately 20 per cent of the total cut of lumber in Montana is shipped out of the state. This would be *from 60 to 80* million per year. This is largely the better *grades of yellow* pine and white pine and a small amount of *Douglas fir* and larch. Common grades of the interior species cannot be shipped long distances because of the weight and low mill run value.

Number of Retail Yards

There are, according to the 1917 "Blue Book," *Vol. 28, 456 retail yards within the state. These yards deal in lumber as their principal business, but most of them handle other products in connection with lumber.

There are 143 other concerns which retail lumber but are not listed in the "Blue Book" as retail yards. This makes a total of 599 concerns which retail lumber, either as a principal business or as a side issue. There are probably a few small yards in the country which are not listed, but the amount of material handled by such yards, if there are any, is such a small percentage of the total business in the state that they need not be considered.

Cost and Selling Prices

Considerable data has been collected concerning the cost prices f. o. b. cars at retail yards and the selling prices. The figures, without detailed analysis, indicate that there is a wide margin between cost and selling prices. One would naturally conclude that the retailer was making an unusually high profit at the consumer's expense. This, however, upon close analysis, is found to be not the case. The retailer in this region usually makes from 12 to 25 per cent on the average investment. During 1917 the margin on the investment was probably a little greater than usual or an average of about 20 per cent.

It is often thought by the consumer when he was to pay from $30 to $40 per M on an average for his lumber that the price is unreasonable and some one is making a big profit. An analysis of the retail business, if carried no farther than the class of material handled, the freight rates and the margin between cost and selling prices, indicates that the retailer is making an unreasonable profit. However, if the retail business is probably analyzed, it will be seen that the prices charged for lumber are not unreasonable, but a good profit is made on the investment. There is detailed data available from about 123 retail yards, showing the number of men employed, the average investment per yard for real estate, sheds, office furniture, yard equipment, lumber carried in stock, and the cost per

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*Issued by the National Lumber Manufacturers' Association.

M for handling lumber from the cars to the consumer. This data was collected for 1917. The following table shows the analysis of the retail business in these yards, which is based partly upon data submitted by retailers and partly upon estimates.

No. of Yards Included	Average Investment Per Yard	Average Amount of Lbr. Handled Per Yard	Average Cost Price Per M Including Freight	Average Selling Price Per M	Gross Margin Per M	Cost of Handling in Yards, Delivering, etc.	Net Profit Per M	Per Cent of Profit on Average Investment
123	$14,000	600M	$26.00	$38.00	$12.00	$ 7.00	$ 5.00	19.2

It has been shown elsewhere in this report that the manufacturer does not make an unreasonably high profit on the investment. The figures in this table indicate that the retailer makes a fair profit but it is not considered exorbitant. The cost of handling lumber from the car to the consumer includes taxes, insurance, depreciation, maintenance of equipment and all overhead. This item ranges from about $4.00 per M as the minimum to about $8.50 as the maximum.

The investment per yard is not believed to be representative for the average yard for the entire state. There are several large yards located in towns where real estate is very valuable and the investment would be much greater. It is believed that $18,000 per yard would be a good average investment for the entire state, and from $6.00 to $6.50 per M for handling charges.

These 123 yards were selected because they were so nearly the same for the investment per yard, the amount of lumbr handled, and the cost per M for handling it.

It seems perfectly evident that the consumer has to pay for too many retail yards. One yard for every 1,000 people in the state is really more than is necessary. In one locality in Eastern Montana eight yards supply 14,000 people; in another locality twenty-one retail yards supply 15,000 people. Numerous cases can be found of duplication of effort in this field. Obviously if the number of retail yards was more nearly commensurate with the population, the cost of lumber to the consumer could be reduced several dollars per M feet. This may or may not be a field for investigation and action by the state government.

Principal Lumber Trees of the State

The available supply, distribution of supply, and production have already been discussed for the commercially important species which grow within the state. It is here intended to summarize in a general way information concerning the characteristics of the different woods, grades of lumber made, and uses to which the material is adapted.

Western Yellow Pine (Pinus ponderosa)

In total value of the product, western yellow pine is the chief lumber producing tree of Montana. In this state it reaches its best development in the Bitter Root and St. Regis Valleys. The wood is light, soft, and resinous, and has a fine even grain. The sapwood is nearly white, usually varying from three to six inches in thickness. The heartwood varies in color from light yellow to reddish brown. The wood is not strong as compared to larch or Douglas fir, but its even grain, smooth finish, easy working properties, and resistance to warping and checking enhance its value for uses of the trades. In its general serviceability for secondary manufacturing plants requiring soft woods, it is excelled only by white pine for which it is often mistaken and substituted.

The following statistics show some of the physical and mechanical properties of western yellow pine (or western pine and western white pine, as it is commonly called in the lumber trade.)

Average weight of oven-dry wood, 26.5 pounds per cubic feet (Sargent).

The green weight is about 46 pounds per cubic feet.

Specific gravity (dry) 0.42.

Fuel value 63 per cent that of white oak (Sargent).

Average breaking strength (Modulus of rupture) of small, clear pieces green, 5200; air-dry, 9800 pounds per square inch. (Forest Service strength tests).

Average factor of stiffness (Modulus of elasticity) of small clear pieces, green, 1,010,000; air-dry, 1,340,000 pounds per square inch (Forest Service strength tests).

The strength under varying conditions of service varies from about 60 to 70 per cent of that of Douglas fir.

Weight of 1,000 feet b. m. of rough green lumber, from 3,500 to 3,700 pounds.

Shipping weight of 1,000 feet (b. m.), of 1-inch rough air-dry lumber, 2,600 pounds; of 1-inch lumber, air-dry and planed, 2,100 pounds.

Utilization

The major product of the yellow pine forests is lumber in its various forms. Western yellow pine lumber is used for almost every purpose to which any pine lumber is put. It has uses ranging from the coarsest construction to highly finished products. House frames, beams, joists, rafters, sills, sheating, and studding are cut in all workable dimensions. Thick finish from 1¾ to 2 inches inch finish, siding, flooring, factory plank or shop common, factory selects, thick common lumber, common boards, ship lap, groved roofing, dressed and matched material, dimension, fencing, and lath are the principal products into which western yellow pine is separated when it leaves the yard or planer. Many of these products are shipped in the rough as they come from the sawmills, but the bulk of the material is run through the planer and either surfaced or re-manufactured into some of the finished forms.

The uses of the wood and the basis for the grades of sawed products are very similar to those of white pine. The tree produces an average of about 13 per cent select, 12 per cent shop, and 75 per cent common lumber, as graded at the larger mills. The proportion of the various grades produced depends not only upon the quality of the timber, but also upon the efficiency of the operation, the size of the mill and the facilities for marketing lumber. Inefficient operations do not cut as high a proportion of the better grades, and small mills without a marketing organization do not take as much care in separating grades.

Western yellow pine is well suited for flooring, although considerably softer than its chief competitors, Douglas fir and western larch. Its even grain and wearing qualities commend its use for flooring and it shrinks or warps comparatively little after proper seasoning. The wood makes excellent fuel for which both the green and dead timber is used. In addition to being sawed for lumber and used for fuel, it is extensively used in the mines of Butte for stulls; also to some extent in the round for house logs and frames, fence rails and posts in the agricultural districts, but for these purposes is inferior to Douglas fir and lodgepole pine. The wood of the yellow pine is not very durable in contact with the soil and as a rule should be treated with a preservative before being used for ties, telegraph poles, or fence posts. The butt logs of dead trees thoroughly impregnated with pitch, however, make excellent fence posts.

It has never been used commercially for paper, but experiments made at the Forest Product Laboratory, Madison, Wisconsin, indicate that it has possibilities for this purpose. With the soda process it yielded pulp with a strong fiber of brown color which would probably make a good grade of wrapping paper. By the mechanical process it yielded pulp which had long fibers and was creamy in color, but coarse, and suitable only for making manila and other papers where color and coarseness are of no importance.

Western Larch (Larix occidentalis)

Montana has about 46 per cent of the total supply of this species in the United States. In 1916 more than 50 per cent of the total output of larch was cut in this state. The total cut reported by Montana sawmills in 1916 was 16 per cent greater than that of western yellow pine, but fell off from 164 million board feet in 1916 to about 138 million feet in 1917, which was 4 per cent less than that of the yellow pine. The heaviest stands of larch are located in the northwestern part of the state.

Description of the Wood

The heartwood is reddish-brown in color, while the sapwood, which is usually from ½ to 1½ inches thick, is yellowish-brown. Western larch lumber is practically all heart-wood, because the sapwood is so thin that it is generally cut off with the slab in sawing the log. The annual rings are clearly marked, each showing two distinct bands, one of light-colored wood grown in the spring, and the other of darker, harder and stronger wood grown in the summer. The grain of the wood is straight and very close. The fiber is hard and tough; holds nails firmly. Knots are generally sound, tight, and not over 1½ inches in diameter. The wood is very durable under conditions where it is exposed to the weather, even when not painted. The average weight of western larch grown in Missoula County, as shown by tests at the Forest Products Laboratory, Madison, Wisconsin, is 51 pounds per cubic foot, green; air-dry weight (at 12% to 15% moisture) 39 pounds; kiln-dry weight (at about 8% moisture) 37 pounds; oven-dry weight, 31 pounds.

Forest Service strength tests of western larch show that it ranks high with other American woods as a structural material. The following average values for small clear pieces tested green were obtained from material grown in Montana and Washington:

Specific gravity oven-dry, based on Volume when tested 0.48.

	Pounds Per Square Inch
Specific gravity oven-dry based on vol. when tested	0.48
Av. breaking strength (Modulus of rupture	7,500
Av. factor of stiffness (Modulus of elasticity	1,350,000
Crushing strength (compression parallel to grain	3,800
Fiber stress at elastic limit (Compression perpendicular to grain	560
Shearing strength parallel to grain	920

Utilization

The bulk of the larch is cut into dimension, common lumber, and timbers for structural purposes, since the stiffness, strength, hardness, and other qualities particularly adapt it for that class of work. It is, however, used for a great variety of purposes ranging from the heaviest construction to the finest interior finish. The tree produces an average of about 8 per cent select lumber and 92 per cent of the common grades.

Owing to its beautiful grain, larch is an excellent wood for interior finish. It does not mar or dent easily and readily takes and holds stains, varnishes, oil finishes and paints. When cut with the grain vertical and properly seasons, the wood makes an excellent flooring material which wears evenly and keeps a smooth surface.

One of the chief objections often made to western larch is that interior finish often shrinks after placing in a building. This is due to the wood being manufactured into finished product before it is thoroughly dry. Forest Service tests show that the volumetric shrinkage of larch is somewhat greater than that of most other western woods, which emphasizes the importance of careful attention to the matter of seasoning. Excellent results have been secured in kiln drying larch green from the saw in the Forest Service humidity regulated kiln. Wide clear boards one inch thick were dried successfully, and it was demonstrated that the losses which ordinarily occur in seasoning larch can be greatly reduced.

Larch is one of the best cross tie woods in Montana and large numbers are used annually. The wood has sufficient strength in side bearing to withstand rail wear well.. It can be easily treated with preservative, and about two-thirds of the larch ties used in Montana are treated either with creosote or zinc chloride. As a material for wood-block paving, larch is very serviceable because of its hardness and resistance to wear. In Spokane treated larch paving blocks have been quite extensively used. In addition to the large amount consumed locally, a considerable quantity of western larch cut by Montana mills is shipped out of the state to the prairie states of the Middle West.

Pulp

Forest Service paper making tests on western larch indicate that although the wood in the mechanical process produces a pulp which can not be manufactured into papers of good color and strength, nevertheless, in the sulphate process the wood produces a pulp which can be manufactured into natural colored kraft wrapping paper of very good strength. The wood is not well suited for the manufacture of pulp in the sulphite process.

Douglas Fir (Pseudotsuga *taxfolia*)

Douglas fir holds third place in Montana in total output *from the sawmills and in the* total value of its products. The annual cut represents from 10 to 15 per cent of the total lumber production of all species in the state.

The wood is considerably lighter than larch but heavier that the western yellow pine in the dry condition. The Douglas fir grown in Montana is rather knotty and coarse grained. The spring and summer wood vary greatly in density. The spring growth is soft and spongy and almost white in color, while the summerwood is hard and flinty and very dark. The growth is more variable than that of larch and the yearly rings may be narrow with very little of the brown summerwood, or broad with nearly as much summerwood as springwood. The proportion of heartwood is usually less than that of larch, but greater than that of yellow pine. The wood is neither as straight grained nor as easily worked as that of the coast fir, but it is highly valued for its strength and durability. Forest Service strength tests of small clear pieces in the green condition show the following average values for material grown in Montana and Wyoming:

	Pounds Per Square Inch
Specific gravity overn-dry based on vol. when green	0.40
Av. breaking strength (Modulus of rupture)	6,400
Av. factor of stiffness (Modulus of elasticity	1,180,000
Crushing strength (compression parallel to grain	3,000
Fiber stress at elastic limit (Compression perpendicular to grain)	450
Shearing strength parallel to grain	880

In pure stands the Rocky Mountain form of Douglas fir does not produce such dense stands nor clear straight boles as the coast fir, and because of its slower growth it forms at a given age a forest of much smaller trees than does the coast fir. Beecause of its smaller size and absence of clear length the Douglas fir cut in Montana does not furnish as high a quality of lumber as that grown in Oregon and Washington. Some of the Montana fir is used for flooring and finish, but the tree cuts a very small percentage of selects, 98 per cent going into common lumber and only 2 per cent in the select grades. At the sawmills most of the fir is cut into rough lumber, timbers and dimension stuff for mining and construction purposes. Its strength and comparative lightness fit it for joists, floor beams, rafters, and other timbers which must carry loads. The greater part of the output is consumed within the state, a large quantity being used by the Butte mines. Both square and round timbers are in some cases cresoted or treated with other preservatives when used in permanent mine work. The round timber is more easily treated because of the soft sapwood which readily absorbs the fluids. In the square form the density of the heartwood hinders the penetration of the preservative. Large numbers of railway cross ties are used annually in an untreated condition throughout the state.

Pulp

To a limited extent paper mills in the Pacific Coast region use Douglas fir for pulp, but it is usually combined with that of other woods. The density of the summerwood of Douglas fir and difficulty of bleaching the pulp make it unsuitable for the finer grades of paper, but good wrapping paper can be produced. The wood may be reduced by either the mechanical or the soda process.

Lodge Pole Pine (Pinus contorta)

Most of the lodgepole pine produced in the state is consumed in the round or hewed form or as fuel wood. The lumber census figures which are for lumber cut only do not indicate the importance of the species. It contributes less than one per cent to the lumber cut of the state, but should be classed as the fourth species of importance in point of production and value on the basis of the total output of mining timbers, posts, poles, ties, and fuel. The total supply of standing timber exceeds that of any other species and in many districts the wood is the most important in its general uses.

The wood of lodgepole pine is straight grained, with narrow rings in which the resinous band of summerwood are conspicuous, though relatively small when compared with the the springwood. It is more resinous than eastern white pine, but less so than the yellow pines of the South and West. In color it varies from almost white to a light yellow or yellow-brown with a tinge of red in the heartwood. Its specific gravity (oven-dry) based on volume when green is about 0.38. The green weight varies from about 39 pounds to 47 pounds per cubic foot. The air-dry weight averages about 28 pounds and the kiln-dry weight 27 pounds per cubic foot. The wood is fairly soft, and is easily worked. Though not so strong as Douglas fir of the Pacific Coast, a heavier wood, tests made by the Forest Service show it to be practically as strong as western yellow pine and stronger than Engelmann spruce and alpine fir, three woods of more nearly its weight. Tests made on lodgepole pine and western red cedar telephone poles cut green and seasoned show lodgepole pine to be the stronger, both in cross bending and in compression parallel and perpendicular to the grain.

Average strength value for green lodgepole material grown in Montana, Colorado, and Wyoming, tested in the form of small clear pieces are as follows:

	Pounds Per Square Inch
Avrage breaking strength (Modulus of rupture)	5,500
Average factor of stiffness (Modulus of elasticity	1,080,000
Crushing strength (compression parallel to grain)	2,610
Fiber stress at elastic limit (compression perpendicular to grain)	310
Shearing strength parallel to grain	690

Lodgepole is one of the smallest of the commercially important pines. In well developed stands approximately 140 years old, at which age the tree may be considered mature, most of the merchantable trees are from 8 to 14 inches in diameter breat high and from 60 to 80 feet in height. Trees up to 20 inches in diameter and 85 feet in height are commonly found, however. Even in mature stands only about 20 per cent of the material is large enough for saw timber and the logs taken out run from 20 to 30 per thousand board feet. Such sizes do not yield wide lumber and are more expensive to log than larger stuff. Owing to the small size of the timber and various other causes the use of lodgepole in lumber has been comparatively small, forming less than 0.1 per cent of the total lumber cut of the United States.

When carefully manufactured lodgepole produces better lumber than is commonly assumed. In quality it ranks between western yellow pine and western white pine and is often mixed with these species. While the sound knots which are characteristic of lodgepole make it difficult to turn out any large quantity of clear lumber, they do not prevent a high percentage from going into No. 1 and No. 2 common of the narrow widths. When manufactured into lumber the tree produces about 7 per cent selects, 93 per cent going into the common grades. At present most of the lodgepole pine lumber is used locally for rough construction and repairs, though in some places where other species are not available it is also used for flooring, siding, and finish.

Figures on the total cut of lodgepole for all purposes in Montana have not been compiled recently, but in 1913 the total amount including that cut from private as well as from National Forest lands was about 30.5 millions board feet. This cut was distributed among the different products as follows:

	Board Feet	Per Cent
Mine timbers	14,632,000	48
Cordwood	8,554,000	28
Fencing	4,083,000	13.4
Saw timber	2,805,000	9.2
Miscellaneous	315,000	1.1
Railroad ties	108,000	0.3
Total	30,497,000	100.

The annual cut has probably increased somewhat during the past five years, but it is estimated that the percentages used for different purposes have not been greatly changed.

The wood is the chief source of stulls, lagging, and converter poles for the Butte mines and Butte affords the greatest single market for this species to be found anywhere. Lodgepole stands supply large quantities of house logs and straight slender poles used for building corrals and fences and it is an ideal timber for ranch purposes.

The wood is not durable in contact with the soil, but is easily treated with preservatives. It yields a ground wood pulp of good quality suitable for the manufacture of news print paper. It can also be made into pulp by the sulphite process.

Western yellow pine, western larch, Douglas fir and *lodgepole pine furnish over 90* per cent of the forest products cut within the state. The remaining 10 per cent is made up principally of Engelmann spruce, western white pine, and white fir. The Engelmann spruce forms extensive stands at high elevations, but has been little exploited thus far. The quantity of western white pine manufactured in Montana sawmills is small compared with the amount of this species manufactured in Idaho.[1] White fir is found in small quantities in mixture with other species in the mountains of western Montana.

Consumption of Forest Products

The lumber consumption in the state in 1916 was computed to be 604 million feet and of all other forest products, such as cordwood, hewn ties, posts, poles, lath, and shingles, 196 million board feet, a total of 800 million feet.

Dwellings

The 1915 census abstract states that there is one dwelling for every 4.5 people in Montana, and at the present estimated rate of increase in population of 15,000 per year, about 3350 new dwellings are required to house the people. This would take 67 million board feet of lumber. There are in the neighborhood of 110,000 dwellings in the state at present requiring an annual amount of 22 million feet of lumber for repairs. Furthermore, lath and shingles amounting to 33 million feet board measure are needed, this making 122 million feet used for dwellings alone.

Farm Improvements

Each year 1700 new farms are established in Montana requiring barns, hay sheds, carriage houses, and various outbuildings. It takes 38 M feet of lumber per farm for these improvements or 65 million feet in the state. At present there are 50,000 ranches: and repairs on these at the rate of 300 board feet per year per ranch would be 15 million feet. It is estimated that one million fence posts are needed on ranches, or 5 million feet, reduced to board measure.

Office and Factory Buildings

No very close check was possible on the amount of lumber used in office and factory buildings but it is estimated at 150 million feet.

Mining

The mining industry is centered at Butte, which takes a large percentage of the total amount of lumber demanded by the industry. Very close figures are available for the Butte consumption as a result of a study of that market by the Forest Service. Adding 10 per cent of the Butte consumption for the rest of the state, the mining companies annually need

132,000 M board feet of lumber
32,000 M board feet of stulls
2,000 M board feet of lagging, and converter poles.

Thus the total consumption of the mines is 167 million feet per year.

Railroads

According to the 1917 valuation survey of the Board of Assessors, there are 7254 miles of railroads in Montana, of which about 1450 miles are side tracks, spurs, and yards, and 5,804 miles in main line tracks. The average annual cross tie replacements were figured at 300 per mile for main line track and 250 per mile for the side tracks, or 2,104,000 ties and another 100,000 is used on the 270 miles of electric road (exclusive of the C. M. & St. P. main line, which is included in the previous figures). Reduced to board feet, 80 million feet are required by the railroads for cross ties; of these, 60 million board feet are sawn ties and 20 million are hewn ties.

Stations and other railroad buildings are included under the heading "Factory and Office Buildings" previously discussed. 200 M. B. M. of poles are used by the various electric railroads but this figure has been combined with the pole figure for telephone and telegraph companies. For repairs on platforms, bridges, trestles, crossing, etc. 20 million feet are consumed annually, bringing the total consumption for railroads in the state up to 100 million feet.

Irrigation

It is estimated that there is needed for the repair of flumes, gates, etc., on irrigation works, not to exceed 6 million feet.

Telephone, Telegraph, and Power Companies Use One Million board feet of cross arms and 42,000 poles which when reduced to board measure give 3 million feet, a total of 4 million feet of all forest products.

The Fuel ***Consumption*** *has* been estimated at 200,000 cords *or 100 million board feet.*

The Wood Using Industries of the state in 1912 took 6 million feet and for the present year, the amount is placed at 8 million.

Miscellaneous

All other needs in Montana are estimated at 58 million feet. These figures are summarized in the following table:

Forest Products Consumed

Class of Use	Volume Million Feet B. M.
Dwellings	122
Farm Improvements	85
Office and Factory Buildings	150
Mines	167
Railroads	100
Telephone, Telegraph and Power Lines	4
Irrigation	6
Fuel	100
Wood Using Industries	8
Miscellaneous	58
Total	800

By kinds of products the consumption is as follows:

Lumber from Montana mills	300,000 M
Lumber from Idaho mills	80,000 M
Lumber from Pacific Coast mills	213,000 M
Ties not included in lumber	20,000 M
Hardwood from the East	1,000 M
Posts	5,000 M
Poles, Piling, etc.	3,000 M
Free use and small sales to settlers	10,000 M
Stulls	33,000 M
Lagging and converter poles	2,000 M
Lath and shingles made in Montana	5,000 M
Shingles shipped in from the Pacific Coast	29,000 M
Fuelwood and miscellaneous products	100,000 M*
Total all forest products	801,000 M

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*The consumption of fuelwood appeared high, but upon close analysis it was found that 100 million feet board measure was a very conservative figure. It is usually figured that one cord of wood is equivalent to 500 feet board measure. It was figured that 250,000 of the population of the state, largely the eastern part of the state, used 50 board feet of fuelwood per year or one-tenth cord per capita; 150,000 inhabitants in the cities and small towns in Western Montana used 300 board feet or six-tenths cord per capita and the remaining 100,000 inhabitants, largely ranchers in the western part of the state, used 500 board feet or one cord per capita. If this figure is in error, it is believed to be low.

According to the most reliable statistics for 1917, the population for Montana was approximately 500,000 people. This was checked by a curve platted to show the increase over a long period and the maximum which could be determined from the curve was 500,000 inhabitants. Using this number as a basis to figure from, the consumption per capita for all forests products expressed in terms of feet board measure is 1,600 feet; excluding railroad ties, mine timber, and fuelwood and reducing it to lumber, lath, shingles, etc., the consumption was about 900 board feet per capita. This figure is an average for the state wsirh is higher tsan for rural communities, where no large consumption for office and factory buildings, railroad, and other special projects brings up the average. For ordinary use such as dwelling, farm improvements, irrigation, etc., the per capita consumption would be between 400 and 600 feet b. m.

Cross Section of Lumber Consumption in Eastern Montana

In the spring of 1918 the Forest Service made two intensive studies of lumber consumption in Eastern Montana, which show some interesting figures. The figures collected cover the calendar year 1917. The Gallatin and Sun River Valleys were selected, the former, one of the oldest and best settled regions in the state, and the latter, still largely in the pioneer stage. The area selected in the Gallatin Valley contained a population of 14,000 people, with eight retail lumber yards and the Sun River, a population of 15,000 people, with twenty-one retail lumber yards. The following table shows the total and per capita consumption by classes of products (not including telephone or telegraph poles).

Consumption of Forest Products in M Feet B. M.

Total

NAME OF AREA	Lumber	R. R. Ties	Farm Timbers (Posts & Poles)	Fuelwood	Shingles	Lath	Mouldings, Sash Doors, Frames	Total
Sun River	7,177 65*	1,831 16.9*	671 6*	444 4*	633 5.5*	133 1.2*	162 1.4*	11,054 100*
Gallatin	4,722 *37.5**	2,267 *18.5**	478 4*	4,503 35.5*	342 2.5*	139 1*	115 1*	12,568 100*

***Per Cent.*

Per Capita

Sun River	457	122	45	30	......	84	......	740
Gallatin	340	162	35	321	—	42	—	900

The following table shows the source of lumber only used in each Valley.

Gallatin Valley

Species of M Feet b. m.

SOURCE OF LUMBER	Native Species	Coast Douglas Fir	La. D. Fir	Y. Pine	W. Pine	Cedar	Total	Per Cent.
W. Coast	......	865	......	......	......	28	893	19
Idaho	......	......	1,257	295	175	29	1,756	37
W. Montan	......	......	354	160	143	......	657	14
Local	1,416	......	......	......	......	......	1,416	30
Total	1,416	865	1,611	455	318	57	4,722	100
Per Cents	30	18	34	10	7	1	100	......

Sun River Valley

W. Coast	......	1,750	......	......	......	199	1,949	27.1
Idaho	......	......	10	......	17	......	27	.4
W. Montana	......	......	4,190	991	......	......	5,181	72.2
Local	20	......	......	......	......	......	20	.3
Total	20	1,750	4,200	991	17	199	7,177	100
Per Cents	.3	24	59	14	.2	2.5	100	......

The following shows the per cents of the grades of lumber used as graded at the retail yards:

Per Cent of Grades Used

NAME OF AREA	Selects Clears and Shop	No. 1 Common	No. 2 Common	No. 3 Common	No. 4 Common	Local Timber Mill Run	Total
Sun River	5	43	13	18	18	3	100
Gallatin	10	41	7	23	3	16	100

It will be noted that the per capita consumption of lumber only is 457 feet b. m. in the Sun River Valley and 340 feet b. m. in the Gallatin Valley. Considering the differences between the stages of development of the two localities, this difference is reasonable. Older well settled communities use less lumber per capita than those in earlier stages of development. The Sun River Valley is believed to be more representative of the greater part of Eastern Montana. Another difference which might be expected is the larger percentage of the select and clear grades of lumber (the most expensive) used in the Gallatin Valley. Older communities are able to afford more luxuries in general than people in the pioneer stage of development; the percentage of urban to rural population is also much greater in the Gallatin than in the Sun River Valley, which, as a rule, means better houses calling for a greater volume of the higher grades of lumber. Forty-five per cent of the lumber sold (including, in this case, lath, shingles, sash and doors) in the Gallatin Valley was for use in towns, and 55 per cent for the country trade. Corresponding figures for Sun River are 19 per cent, town trade, and 81 per cent, country trade. The fuelwood consumption in the two regions were approximately the same as to urban and rural, 10 per cent being for town use and 90 per cent for use on farms.

There is a very striking difference also in the quantity of wood fuel consumed in the two localities as well as in the total fuel (wood and coal) consumed. Converted to feet board measure, the Sun River uses 30 feet and the Gallatin 321 feet per capita. The coal consumption in Sun River amounts to 23,000 tons and in the Gallatin, 30,000 tons. Reducing this to feet b. m. (on the basis of 1 2/3 cords wood equals one ton of coal and 500 feet b. m. per cord of wood), the total consumption of fuel in terms of lumber is 1302 feet b. m. for the Sun River and 2100 feet b. m. for the Gallatin, per capita. Considering that the Gallatin Valley includes the comparatively large city of Bozeman, the Agricultural College, and several large flour mills, a brewery and other fuel-consuming industries, not represented in Sun River, the difference seems reasonable. The *wood fuel consumption* of Sun River is more representative *of Eastern Montana* conditions than is the Gallatin figures.

ECONOMIC IMPORTANCE OF THE LUMBER INDUSTRY

Investment in Business

The economic importance of any industry can best be determined from the investment represented in that industry, the labor it furnishes and the number of people that it supports directly or indirectly.

If the lumber industry in the state is analyzed on this basis, it would seem to be one of the most important industries in the state and in some respects it is by far the most important. Agriculture and mining are, of course, the most important industries, but these could not be economically and successfully operated unaided by the use of forest products. For that reason the forest resources, especially the timber, is without question first in importance if considered broadly.

All available data has been collected and an estimate of the investment in the lumber industry is given below. These figures are of necessity only estimates, but they are believed to be reasonably close to the actual facts.

As nearly as can be determined the investment is as follows:

Logging equipment	$ 1,000,000
Logging railroads, steel etc	1,080,000
Manufacturing investment (Mills)	4,000,000
Planing mills, sheds, real estate, etc.	2,000,000
Investment in logs on hand	400,000
Lumber carried in stock	6,000,000
Other forest products	2,700,000
Retail yards, including lumber	8,723,000
Stumpage	17,260,000
Transportation; investment in equipment, transportation lines, etc.	34,819,200
Total investment rounded off to	$78,000,000

As the total investment is much greater than the figures which have been formerly compiled, some of the items need explanation.

The investment in retail yards and transportation equipment have not been included in previous reports. Data from about 123 retail yards show that the average annual profit bearing investment ranges from $11,000 to $19,000 per yard. The average for the state was placed at $18,000 per yard for the reason that no large yards were included in the 123 yards. There are 456 retail yards in the state and 143 other concerns which handle more or less lumber. The 143 yards referred to were estimated to have an average investment of $5,000.

The investment in transportation facilities was much more difficult to determine. According to the statistical report of 1917, Board of Assessors, there are 5,804 miles of main railroad and 1,450 miles of spurs, side tracks, etc., in the state. This makes a total of 7,254 miles. The investment in this mileage, including everything except the passenger equipment is estimated to be $40,000 per mile. On this basis the total investment is $290,160,000. It is estimated that from 12 to 15 per cent of the total tonnage originating in the state is lumber and other forest products. Twelve per cent of the total investment was charged to the lumber industry in arriving at the total investment in that industry. This amounts to $34,819,200.

It is believed that these figures are conservative. Statistics show, for the United States as a whole, that slightly more than ten per cent of the entire tonnage handled during 1914 was lumber and other forest products.

The statistics show, for the western district, that forest products comprise 16,68 per cent of the total tonnage while agricultural products account for 17,20 per cent of the total. The products from mines in the western district constitute 43.28 per cent of the total tonnage, while manufactured products comprise only 12.55 per cent.

It is, therefore, very evident that the lumber industry and other forest products furnish a large portion of the freight business and from that point of view they are among the most important industries.

Probably the total tonnage from any given industry is not the best index to the importance of that industry fram a traffic point of view, because the rate per ton varies greatly for different commodities, and the haul also varies considerably. An analysis of the average haul, the revenue and average receipts per ton-mile is probably the best comparison. In the following table seven commodities are selected for this purpose. These figures are taken from the statistics of railways in the United States for 1914.

District	Commodity	Number of Tons	Number of Ton-Miles	Revenue	Av. Receipts Per Ton-Mile-Cents	Av. Length of Haul-Miles
Western	Grain	24,537,231	5,389,373,751	$41,322,930	0.767	219.64
Western	Hay	3,445,889	523,156,568	6,043,796	1.155	151.82
Western	Livestock	8,315,039	1,749,226,521	24,558,161	1.404	210.37
Western	Dressed meats	978,009	336,201,540	3,584,746	1.066	343.76
Western	Anthracite coal	2,477,213	483,146,301	3,108,634	0.643	195.04
Western	Bituminous coal	44,276,336	6,050,456,162	37,612,063	0.622	136.65
Western	Lumber	40,832,434	7,905,602,432	56,954,077	0.720	193.61

The boundary of the western district is about as follows: Bounded on the northeast by the northwestern shore of Lake Michigan to Chicago, thence by line through Peoria to St. Louis, thence down the Mississippi River to its mouth. Alaska and the Island possessions are not included.

It was not possible to compile the classification of freight orginating in Montana. The western district selected is believed to be fairly representative for this state, except that the tonnage from forest products would probably not be as great a percentage of the total for Montana as for the whole western district and for that reason it was estimated that 12 per cent would be a safe figure to use.

Number of People Employed in Lumber Industry

It is not possible to show the actual number of people employed in the various activities, but a knowledge of operating costs and the amount of forest products handled annually make it possible to closely approximate the number of people employed in the woods, mills and retail yards.

Every thousand feet of logs that is cut and transported to the mill under present conditions represents from 1.5 to 2.5 man-day's labor. It is believed that two man-days' labor per M feet b. m. is a fair estimate. Telephone, telegraph and power poles, piling, stulls, lagging, and converter poles represent considerably more labor for each thousand feet handled.

The labor for manufacturing lumber is not as much per M as for logging. The labor for manufacturing from pond to car varies from about 1.1 to 1.4 man-days per M feet of lumber. Some of the most efficient band mills may hold the labor down to one man-day per M, while some of the small mills would be as high as two man-days per M.

These figures are intended to include only the actual labor necessary to produce one M feet b. m. of logs or lumber. Depreciation, maintenance, taxes, insurance, general overhead, etc., are not considered in this part of the discussion.

The following table shows the estimated number of men employed in the production of forest products. It is believed that the employees in retail yards should be included because that is one of the important features in the lumber industry.

Men employed in woods	7,000
Men employed in mills	2,000
Men employed in retail yards	1,200
Miscellaneous	1,800
Total	12,000

These figures are based upon an estimated average effective year of 200 days each for the logging and manufacturing. Because of the large overturn the actual number of men on the payrolls would greatly exceed these figures.

The number of men employed in the woods includes loggers, pole and stull makers and tie cutters. Miscellaneous includes cruisers, labor for fire protection, wood cutters, post makers, etc. It is believed that there are from 10,000 to 15,000 men employed in the various activities listed here.

Only a small percentage of the woods workers are married, but a large percentage of the mill employees and employees in retail yards have families. It is estimated that the lumber industry supports directly from 25,000 to 30,000 people. The number that is supported from other lines, such as building, secondary wood-using industries, etc., has not been included. According to the most reliable statistics there are at least 31 secondary wood-using industries in Montana. How many employes this represents is not known.

Labor Costs of Handling Forest Products

If the total business directly resulting from the forest products cut in Montana during 1916 could be completely analyzed, the importance of protecting and properly managing the forests so as to maintain a perpetual supply of mitber would be evident without further discussion.

It costs in supplies, labor, transportation, etc., about $8.00 per M to do the logging. It costs at least $6.00 per M to manufacture, including all costs from the pond to f. o. b. cars. The costs for 1917 were, of course, considerably more. The average freight paid per M for each M feet b. m. shipped varies from about $2.50 to $6.50, with an average of probably $5.00 per M for all forest products cut. Handling in retail yards is estimated at $6.00 to $8.00 per M for material actually handled and about $4.00 per M prorated over all products handled.

The cost of putting the material in final place, such as laying ties, building bridges, trestles, houses, barns, granaries, etc., varies from about $7.50 to $15.00 per M. The cost of replacing ties under present labor conditions would be from 25c to 30c per tie, or from $7.50 to $9.00 per M. The cost of building barns, sheds, granaries, and similar structures would vary from $6.00 to $10.00 per M. Structural construction, bridges, trestles, etc., would range from about $15.00 to $25.00 per M. The cost of putting telephones, telegraph, power poles and piling in place would be much more per M feet b. m. than for the lumber.

The cost of dwellings varies greatly per M for different parts of construction. Setting up studding and framing walls of wooden dwellings would cost under present wages about $18,000 to $20.00 per M. Framing and setting floor joists 2x8 to 2x12 would cost $16.00 to $18.00 per M. Framing and setting heavy joists and girders 6x12 to 10x14 would cost $14.00 to $16.00 per M. The cost of laying 4-inch flooring would cost from $35.00 to $40.00 per M.

The average labor cost of construction or putting into final place is estimated to be $20.00 per M. It is believed that this would be a fair and conservative weighted average per M feet b. m. for the labor of putting these forest products into final place after delivery of the finished product. The various figures making this total are estimates, but the are sufficiently correct to be used as an illustration.

The following tabulation shows the estimated average expenditure in labor, supplies, and transportation, for each thousand feet board measure of forest products that were cut in this state during 1916, from the stump to final place.

Item	Cost Per M
Logging	$ 8.00
Manufacturing	6.00
Freight or wagon haul	5.00
Handling in retail yds., selling, delivering, maintenance, depreciation, overhead, bad accts., etc., $6.00 to $8.00 per M, estimated average on total cut	4.00
Construction, buildings, etc.	20.00
Total Costs	$43.00

These figures do not include the furniture and other wood-using industries which spend considerably more for each M feet handled. Cordwood converted to board measure represents only about $10 per M feet in labor as compared to other products.

If the total cut of forest products (excluding cordwood) in Montana during 1916 is placed at a round figure of 495 million feet b. m. and the cost of handling from the stump to final place is rounded off to $40.00 per M for supplies, freight, labor in logging, manufacturing, retail yards, constructing houses, bridges, and other structures and purposes, the industrial importance to the state directly and indirectly is $19,800,000.00; and including cordwood at $10.000 per M feet makes a total of $20,800,000.00.

If the average wage scale for 1916 is placed at $4.00 per day, the total number of effective days represented by the above sum is 5,200,000 days. This divided by 300 days, the result is 17,333 work years of $1,200 per year, which is more than the average American family earned during 1916. In other words, the forest products cut in Montana during 1916 represents enough in labor, supplies, freight, etc., to support 17,333 average American families, or about 70,000 people, slightly more than 14 per cent of the entire population of Montana.

Some Interesting Comparisons

The best stands of mature timber for large areas will average about 20,000 feet b. m. log scale per acre. For a tract of 160 acres the *total log scale* on this basis would be 3,200,000 *feet b. m. A large portion* of the logs cut in this state *are transported by rail* for a distance of 10 to 100 miles.

Saw logs will average about 8,000 pounds or four tons per 1,000 feet b. m. On this basis 160 acres of the best stands of timber would yield 12,800 tons of freight in the form of sawlogs. The lumber overrun over log scale is not, on an average less than 20 per cent. The yield of lumber, then, from the same area would be 3,840,000 feet b. m. The total freight in lumber would be 9,600,000 pounds, or 4,800 tons, assuming that the shipping weight of Montana lumber and timbers will average 2,500 pounds.

The average yield of wheat for the state of Montana during 1916 was approximately 19 bushels per acre. Placing the weight of wheat at 60 pounds per bushel, the total amount of freight produced from 160 acres of wheat would be approximately 91 tons per year. On this basis, it would require about 140 years for 160 acres of wheat to yield the same number of tons of freight as 160 acres of the best stands of mature timber in the form of sawlogs, and approximately 53 years to produce the same amount of freight as 160 acres of timber would yield in lumber. Assuming 140 years as the average age at which Montana timber matures (and this is a conservative figure) 160 acres of timber lands will produce under forest management about 35 tons of freight in the form of lumber annually, which is about 38½ per cent as much as wheat land produces, based on the 1916 average. Considering the relative topography and productive capacity of the two classes of land, this is a very important economic consideration. Timberland, which we are considering, it must be remembered, will not grow wheat or any other profitable agricultural crop and is fit only for timber production.

Assuming that 8,000 feet b. m. log scale is a fair load of logs, the forest products cut in Montana during 1916 would require at least 52,000 cars to haul the logs in one load. This would make a train approximately 416 miles long, which would reach from Spokane to Helena with 39 miles to spare. The tonnage would be slightly more than the production of hay for the entire state during 1915.

If all the forest products cut in Montana in 1916 were converted into board feet, the lumber would be sufficient to make a sidewalk four feet wide and one inch thick 24,621 miles long, which would reach approximately around the world, or from New York to San Francisco 7.8 times. There would be sufficient material to make a solid block of wood one mile square and 18.7 feet high.

Looking at it from another angle, the forest products cut in Montana during 1916 would make enough lumber to construct approximately 34,700 modern five-room cottages of average size which would be equivalent to about eight towns the size of Missoula.

If all the forest products cut in Montana during 1916 had been cut into cordwood it would be equivalent to all the spruce pulpwood cut in Maine, Massachusetts, Michigan, Minnesota, New Hampshire, North Carolina, Oregon, and Pennsylvania during 1914.

The actual average labor cost of lumber delivered to the consumer at the retail yard, not including stumpage or the profit to which the manufacturer and the retailer are entitled, is about $20.00 per M feet. Twenty-five per cent of this cost is freight, and **this timber is grown within the state!** It is easily apparent that the freight item alone will greatly increase the cost for lumber shipped longer distances. The consuming public is, therefore, interested in maintaining a continuous lumber business in the state for at least two very vital reasons: (1) because it means the cheapest lumber it will be possible to obtain; and (2) almost all of the land now naturally forested must either produce timber or become practically waste land, and this means higher taxes on productive land and fewer people to meet the burden.

The people of the state should wake up to the immense economic value of forests and the industry which they support and take action to insure the source of supply of the raw material and so regulate the cut that Montana will always have a thriving industry. The immediate need is a strong State Forestry organization which will keep the people and the state government informed concerning the need for action. That is the only instrument through which effective results can be obtained.

WHAT THE STATE SHOULD DO FOR THE FOREST INDUSTRY OF MONTANA

In the foregoing pages, an attempt has been made to present a picture of the present and future possibilities arising out of the possession of abundant forest wealth. The Creator gave to Montana three great natural resources with which to build an empire: rich agircultural lands, wonderful mineral resources, and abundant forest wealth. The development of the first two is dependent in large measure upon the third. A resource, the development of which support directly some 25,000 or 30,000 people and indirectly 70,000 people or 14 per cent of the present population, surely demands careful consideration upon the part of those responsible for the future welfare of the state.

When we consider that the future expansion in the lumber industry will mean the support of two or three times this number of people, that the lands which support timber must (except for a very small percentage) continue to grow timber or become non-productive waste land, that the future of the business is entirely within our hands—to develop and conserve and stabilize, or allow to expand and grow disproportionately as a mushroom, leaving nothing for future generations, we begin to realize that the preservation and right use of this resource is a matter of very great public concern.

It is not a question of a few needed laws only (although they would help) or of any overshadowing crisis which we are approaching. No man can tell now just what ought to be done to insure the state against the economic loss of so great an industry. This is a question of adapting a forest policy to the changing and growing needs of the people. This requires careful study and consideration of all factors in the case at various stages of development. What is needed is a strong Forestry Department of the State Government, which, through constant study of the problem, will be able to formulate a far-sighted forest policy and ask the support of the people and the legislature in carrying it out. Obviously, a very important part of the job is to inform the people and keep them informed of conditions and needs. Constant attention to the interests and welfare of the people of the state for all time is needed to bring about a wholesome and satisfactory condition of affairs. Any other policy will result in wasting the heritage of forest wealth so generously provided and that in turn means a serious hindrance to the reaching of the fullest economic prosperity.

With the broad and far-reaching purposes of forestry in mind, I have attempted to indicate more specifically a few of the things the state should do in the immediate future.

(a) Commit itself, like the national government to a policy calling for the highest use of all lands.

(b) Classify the forest lands of the state and designate those of greatest value for permanent forest production regardless of ownership.

(c) Adopt measures which assist private, state, and federal owners to consolidate holdings so as to permit economical administration.

(d) Exercise some control of private lands with reference particularly to:

  (1) methods of cutting so as to insure restocking of the land with trees;

  (2) disposal of brush and debris left from logging to minimize the fire risk;

  (3) distribution of cutting with reference to permanent industries;

  (4) control of forest fires.

(e) Cooperate with the National Forest Service in regulating the cut to the limits of forest productivity. To do this will mean:

  (1) some control over the number, location, and size of sawmills;

  (2) collection of data on rate of growth of timber, distribution of age classes, etc.;

  (3) silvicultural management of state forests;

  (4) prevention of private owners from withholding ripe timber from the market when such policy interferes with development of local communities.

(f) Adopt measures for educating and making good citizens of woods workers. This means coordinating industries to make possible year-long employment and establishment of homes.

(g) Directly assist the lumber industry in:

(1) gathering statistics of lumber manufacture, shipments, and consumption;

(2) making a study of Montana markets and taking such action as may be possible to reduce the cost of lumber to consumer;

(3) educating the people to use Montana forest products by giving euthentic information as to their uses and values compared to other woods;

(4) making a study of wood substitutes and compiling data concerning relative values;

(5) studying efficiency of methods of logging and milling in order to reduce costs;

(6) creating an organization capable of impartially appraising stumpage values and scaling logs when in dispute.

RECOMMENDATIONS

1. An adequate Forest Fire Law defining a closed season from June 1st, to September 30th, inclusive, of each year, during which it would be unlawful for any person to set out, or cause to be set out, fires in any forest material without first procuring a permit therefor from certain designated officers: A copy of such proposed law, as well as the necessity thereof is fully set out in the article "PROTECTION OF PROPERTY AGAINST SLASH FIRES IN WESTERN MONTANA" embraced in this report.

2. Having had numerous applications for the purchase of Lodgepole Pine, this office has had to refuse the sale of same; under the present State Forestry Laws (Chapter 147—1909 and Chapter 119—1911) no timber can be sold that is less than 8 inches in diameter, 20 feet from the ground.

There is at least 75% of Lodgepole Pine that matures and decays before reaching the dimensions required by law, and is blown down, causing dangerous fire traps.

I respectfully recommend that the coming Legislature will amend the present laws so as to enable this office to dispose of this class of timber, thereby increasing the receipts of the office and will also avoid a dangerous fire menace, otherwise proving a total loss of thousand of dollars to the state.

3. A law authorizing the State Forester to sell without advertising live timber in quantities not to exceed five hundred dollars in value.

Having had applications from single individuals for immediate purchase of small amounts of Tie and Saw timber, a number of such sales have been lost to the state by having to comply with the present laws in regard to advertising same. From the date of application, advertising timber, and office work, from six to seven weeks elapse before the sale can be made, together with expense for each contract, averaging $15.00.

I respectfully request that the State Laws be so amended, to allow the State Forester to sell up to $500 worth of timber without advertising.

4. A law requiring any person, firm or corporation engaged in the cutting or removing of timber, logs, ties, poles, wood or other forest products, from lands within the State of Montana, whether public or private, to burn or otherwise dispose of the brush, slashings and all inflammable material incident to such cuttings, at such times and under such methods and restrictions as may be provided by law.

This law is urged for the following reasons: Practically all Forest Fires have their origin in dry, old and long neglected brush heaps and slashings, and until disposed of are a constant menace, furnishing fuel for fires once started, are very hard to control. I am convinced that a law enacted along these lines will reduce the fire hazard at least 40 per cent.

FORESTRY BUILDING

The importance of the lumber industry of Montana suggests the need of a Forestry Exhibit Building. Such a building should be located at the State Fair Grounds where forest and mill products can be assembled and displayed and publicity given showing the methods followed for the preservation of the great natural timber resources of our state as well as the necessity for making them permanent and increasing their value.

I feel this matter justifies the serious consideration of our Legislature. A suitable building could be erected for

$15,000. The great interest manifested by citizens engaged in the lumber industry justifies this department in stating that $5,000 of the amount could be raised by private subscription. I therefore suggest that the Legislature make an appropriation of $10,000, contingent upon the securing of $5,000 by private donation.

Such a building would make a handsome additional structure to the State Fair Ground where a permanent exhibit of Montana's lumber industry can be displayed.

AERO FOREST FIRE PATROL

It is estimated that Montana has a present stand of 58 billion feet, board measure, of mature merchantable timber and that the State of Montana owns 4% or about two and one-third billion feet.

The preservation of this great asset and industry devolves in a great measure upon the state, in cooperation with the Federal Forest Service and Protective Associations.

The greatest menace to our forests, at this time, is their destruction by fire. And in the development of a system of protection from this source, the method now in use is patrolmen, lookouts, and trail building with connecting telephone lines.

Agencies now engaged in forest fire protection in Montana annually employ 350 patrolmen and lookouts, for the summer period at an annual cost of about $60,000. This is the present annual force for patrol work only, and is inadequate and should be greatly increased.

For fighting and suppressing forests fires during the year 1917, the total cost to all cooperating agencies in Montana, was the huge sum of $480,000, with resulting damage of $300,000.

The adoption of measures and means to quickly discover, locate and report fires in our forests is of the greatest importance; and in this connection I suggest the use of aeroplanes. From a limited investigation on the subject I feel justified in recommending the use of an Aeroplane Forest Patrol during the dry summer months, and that their use will prove practical, economical and the most adequate means for the prevention and suppression of forest fires.

Two men with an aeroplane, from an elevation of from two to three thousand feet could overlook a forest area forty miles in width and for an unlimited distance in traveling over the water-sheds of the state, thereby doing more effectively, patrol work than under the present system requires the employment of a great many men. As an estimate I would say one machine would equal the services of 60 men.

The war has caused great development in the navigation of the air, and demonstrated the practical commercial use of aeroplanes, as well as training great numbers of our boys in their use, which should make available both men and machines for such service and at a reasonable cost.

I respectfully submit this proposition for serious consideration by the State Board of Land Commissioners, with a view of authorizing this department to secure such equipment for the coming fire season.

UNIV. OF CALIFORNIA

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ECONOMIC USE OF THE FOREST OF MONTANA

By

JOHN F. PRESTON

Assistant District Forester, U. S. Forest Service.

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IFTH ANNUAL ANNOUNCEMENT

Forest School

State University of Montana

MISSOULA, MONTANA

Instruction in Forestry That Is Practical

JULY, 1919

University of Montana Bulletin

STATE UNIVERSITY SERIES NO 224

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Under the Act of August 24, 1912.

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**Resigned

IF THIS BOOKLET INTERESTS YOU, PASS IT ALONG AND WRITE FOR FULLER DETAILS

ANNOUNCEMENT

THE war is over, and with peace has come an incessant demand for trained men in the Lumbering and Forestry fields. The need of proper training for this work has never been so apparent. Never before have the Forest Service and the Lumbermen so urged and required a combination of professional training, practical ability and familiarity with woods work in all ranks of their employees. Forestry inevitably will be extended to private timber holdings. Never has opportunity been so bright for the trained man. Here is opportunity.

The Forest School of the University of Montana can give the training needed.

For further information address

FOREST SCHOOL

University of Montana
Missoula, Montana

University of California

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Requirements for Admission

Collegiate Course

Applicants, unless entering as Special Students, must have completed a high school or preparatory course of four years, must be at least 16 years of age, must be prepared to give satisfactory evidence of their moral character.

Mature students, who are not preparatory or high school graduates and who are not candidates for degrees, may be admitted without the usual entrance credits as special students, if they give satisfactory evidence that they are prepared successfully to undertake the courses desired.

Special students may acquire status as regular students and become candidates by complying with the rules applicable to such cases.

Ranger School

The following will be admitted as students in the Ranger School:

Forest rangers, guards, and other employees of the U. S. Forest Service.

Employees of corresponding rank with logging and lumbering companies.

Any person of good character at least 19 years of age having experience in forestry or woods work and who can furnish evidence of his ability to pursue the subjects as outlined.

Further information relative to the entrance qualifications of individuals will be given upon application to the Dean, Forest School, University of Montana, Missoula.

Advantageous Location

The Forest School of the University of
.ontana is located near the headquarters of
istrict No. 1 of the Forest Service, and the
ffices of supervisors of the Lolo, Missoula,
ad Bitterroot National Forests. These For-
ats are immediately adjacent to the School.
a Missoula, a town of 18,000 population,
re three sawmills cutting over 100,000
eet per day. Within a radius of 50 miles
om the campus are 11 National Forests, or
overnmental timber reserves, and 10 saw-
ills and logging operations, all readily
ccessible. Every forest type of the North-
n Rocky Mountain and Inland Empire re-
ons is represented in the vicinity, while on
.e campus a 25-year-old stand of the prin-
pal Eastern hardwoods is available for
udy.

The student receives full benefit from
ese resources. Specialists from the staff
the Forest Service, Lumbermen and State
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ents by lectures or the giving of complete
ourses. Much of the work in Lumbering
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es of adjacent lumber companies.

he University furnishes the Forest School
udents with motor transportation for field
ips.

The Forest School is located at the foot of
lount Sentinel. On the summit of the
ountain, a part of the campus, 1960 feet
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s one of their regular stations is maintained
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EXPENSES

Tuition fees are not required of students in the University of Montana. A matriculation fee of $10.00 is charged all students each year, besides which an annual fee of $10.00 is collected to cover membership in the student organization, Associated Students of the University of Montana. This membership admits students to all games, athletic or other contests, special lectures, and school activities.

Board and room may be obtained in the University Dormitory for men, Simpkins Hall, at a rate of $22.50 per month.

All students living within the State of Montana are entitled to have railroad fare in excess of $5.00 refunded upon presentation of receipts for the expenditures.

The total expenses are:

Registration fee	$ 10.00
Associated Students fee	10.00
Library and Laboratory deposits	7.00
Drafting instruments, books, etc.	20.00
Board and room (Simpkins Hall) 9 months at $22.50	202.50
	$249.50

Expenditures for entertainment, theaters, laundry, clothes, vary with the personal tastes and resources of the individual.

The fees for the Ranger course are proportionately reduced.

Fees (approximately)	$ 15.00
Drafting instruments, books, etc.	20.00
Board, 3 months	60.00
Room, 3 months	7.50
	$102.50

Living at the Dormitory is optional. Ordinary expenses are from 25 to 50 per cent lower if the student is domiciled in Simpkins Hall.

Collegiate Courses in Forestry

Two distinct lines of specialization, both leading to the degree of B. S. in Forestry are offered by the Forest School of the University of Montana, the one requiring a maximum of work in Forestry and fitting the student for technical and administrative positions in the Forest Service or in charge of conservative Forestry for a Lumber company, the other primarily adapting the man for responsible situations in the Logging and Lumbering field. This specialization has been made possible by the natural advantages surrounding the School and is obtained in the Junior and Senior terms after a common foundation has been laid during the first two years. This is clearly indicated by a study of the curriculum as given on Page 9. This curriculum was prepared at a joint conference with the Forester of the U. S. Forest Service, District Foresters, other Forest Officials and the leading Lumbermen of the region, and represents, as nearly as possible, the ideal arrangement of courses to fit best the needs of the Forest Students whose professional work will be within the Rocky Mountain region and the Northwest.

In view of the diversified conditions affecting Forestry and Lumbering in the United States it is manifestly impractical for any one Forest School to cover adequately the entire field within the limits of a four-year course. By concentrating the work of the Forest School of the University of Montana upon western conditions and referring only to the other regions as may be necessary to give a broad, general knowledge of the entire field, and by requiring the student to spend his summers in the employ of the Forest Service or with a Lumber Company, the graduates are fitted to undertake positions of responsibility in the West since their four years specialized training and their three seasons practical work in the woods have granted them the experience necessary for successful supervision and administration immediately upon graduation. Since the students are able to vary their practical work from season to season they are definitely able to decide upon the line of activity they desire to follow.

The decision as to the line of specialization must rest with the student. The Forest School of the University of Montana offers unequalled advantages for either. In

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Missoula - - - Montana

public service, as exemplified by the Forest Service, the Forester must treat with the broader aspects of forest research, reforestation, utilization, the conservation of the water flow for power or irrigation, the handling of the ranges, the sale of the forest products and the problems of administration upon the 160,000,000 acres of National Forest. In private practice the call is already insistent for men to act as "future leaders of approved principles of harvesting, manufacturing and marketing timber crops" and eventually for reforestation. This class of men is not now available. "The largest and most efficient companies are the ones who are keenest for employing technically trained men. They recognize the permanent worth of scientific leadership." Personal opportunities are equal in either line for the man who has the education and the practical training to fit him for the existing vacancies.

For a detailed description of the courses or for further information, apply to the Dean, Forest School, University of Montana.

Employment for Students

Many students are earning all or a portion of their expenses while attending the University. This is not possible for Ranger school students. Nearly all of the Forest School students are employed in Forestry work during the summer months. The Forest School has never been able to fill the demand at wages varying from $60.00 to $100.00 per month and expenses. This work assists greatly in defraying the expenses of the student during the following school term. There has never been a student in this school desiring to earn his way, or a part, who has not been able to do so. The school does not promise such work to prospective students, as the ability to secure this employment will depend upon the student himself, in the classroom, on the campus, and the extent to which the Faculty of the Forest School can recommend him.

RANGER SCHOOL

The 10th annual Ranger School of the University of Montana will en on January 3rd, 1920. Founded in 1910 at the request of the For- t Service, its service to forest officers and lumbermen has kept pace th the progress of their profession.

It is the purpose of this school to enable Forest Rangers and other rest Officers to keep abreast of their profession. Forest Adminis- ation is rapidly passing into the hands of a highly technical organi- tion, consequently the need of special training is becoming daily more parent to the wideawake Forest Officer in order that he may main- in his position with satisfaction to himself and his superior officers. en desiring to enter the Forest Service find the Ranger School an cellent foundation upon which to undertake the necessary examina- n. How well these functions have been accomplished is testified to the 30 to 50 men who have attended each year.

The work of the Ranger School has been carried on in close co-op- ation with and under the supervision of the Forest Service. Its ex- rts are detailed under authorization of the Secretary of Agriculture special lecturers in the Ranger School. The faculty have had long perience in the Forest Service either as Logging Engineers, Forest pervisors, Engineers, or Forest Assistants. They know what is need- and how to impart the training. If the desire is to specialize, oppor- nity to do so is offered in Lumbering, Scaling, and Cruising, Survey- g and Mapping, Range Management, Forest Improvements, or Log- ng.

All students enrolling in the Ranger School will be required to reg- er in the following courses:

Surveying and Mapping	5 cr. hours
Improvement Construction	3 cr. hours
Forest Botany	3 cr. hours
Forest Administration	1 cr. hour

In addition each student will be required to register in five or six edit hours from the elective subjects listed below in order to bring total registration to 16 or 18 hours. The student will be carefully uided in his selection of electives that he may choose those subjects at will be of the greatest benefit to him after leaving school. As an ample men who expect to work in the forests of Northern Idaho or Vestern Montana or similar regions, will be advised to register in Scal-

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g and Cruising, while men from the grazing forests should select Botany of R ants, Range Management, etc.

The electives to be offered again during the 1920 session will be as follows

Fire Protection	3 cr. hours
Lumbering and Logging	4 cr. hours
Scaling and Cruising	3 cr. hours
Botany of Range Plants	4 cr. hours
Range Management	4 cr. hours
Computations	3 cr. hours
Geology	3 cr. hours
English	3 cr. hours
First Aid to the Injured	1 cr. hour
Typewriting	2 cr. hours

A credit hour represents 3 hours of time each week throughout the term, c ed in lectures, recitations, field work and outside study or preparation.

For those who desire a second year at the Ranger School, or who have l alified by previous training, the following advanced courses will be given:

Topographic Surveying and Mapping	2 cr. hours
Logging Engineering	3 cr. hours
Tree Diseases	3 cr. hours
Insect Control	3 cr. hours
Forest Appraisals	3 cr. hours
Range Management	2 cr. hours
Physics	3 cr. hours

Tentative Curriculum

1919-1920

First Year

JMN QUARTER	
ctober-January	
duction to Forestry	2
ying	2
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Trigonometry	5
ge Education	1
ry Drill and Phys- Education	2
	18

WINTER QUARTER	
January-April	
Surveying and Mapping	3
Shop Work (wood or iron)	1
English	5
Botany	4
Spherical Trigonometry	3
Military Drill and Physical Education	2
	18

SPRING QUARTER	
April-June	
Fire Protection	3
Surveying	2
Mapping	2
English	5
Economics (13)	4
Military Drill and Physical Education	2
	18

Second Year

JMN QUARTER	
Scaling	2
Surveying and Mapping	4
Rule	1
Protection	3
cs	5
ry Drill and Phys- Education	2
	17

WINTER QUARTER	
Forest Measurements	2
Plant Physiology	3
Forest Improvements	3
Math. of Investments	3
Physics	5
Military Drill and Physical Education	2
	18

SPRING QUARTER	
Cruising	2
Dendrology	3
Economics of Forestry	2
Top. Surv. and Mapping	4
Business English	4
Military Drill and Physical Education	2
	17

Third Year

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gth of Materials	3
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t Policy	3
	18

WINTER QUARTER	
Silviculture	3
Wood Utilization	3
Pathology and Entomology	3
Logging	3
Forest Mapping	2
Graphic Statics	2
or	
Forest Policy	3
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SPRING QUARTER	
Silviculture	3
Accounting	4
Forest Products	3
Logging	3
Logging Railroads	3
or	
Forest Policy	3
	16

Fourth Year

JMN QUARTER	
t Management	3
Technology	3
t Appraisals	2
ing Engineering	3
ration Finance	5
or	
e Management	3
inistration	2
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WINTER QUARTER	
Forest Management	3
Improvement Construction	3
Lumbering	4
Forest Engineering	2
Advertising and Selling	5
or	
Range Managemeent	3
Administration	2
Elective	2
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SPRING QUARTER	
Forest Management	3
Thesis	5
Contracts and Specifications	2
Stream Measurements	3
Investment and Speculation	3
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Range Management	3
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Calendar 1919-1920

Autumn Quarter

Sept. 26, 27, Friday, Saturday	Registration Days
Sept. 29, Monday	Instruction begins
Nov. 27, Thursday	Thanksgiving Day, holiday
Dec. 16-19, Tuesday-Friday	Examinations
Dec. 19, Friday, 4:30 p. m.	Quarter ends

Winter Quarter

Jan. 3, Saturday	Registration of New Students
Jan. 5, Monday	Instruction begins
Feb. 12, Thursday	Lincoln's Birthday
Feb. 17, Tuesday	Charter Day
Feb. 22, Sunday	Washington's Birthday
Mar. 24-27, Wednesday-Saturday	Examinations

Spring Quarter

Mar. 27, Saturday	Registration Day
Mar. 29, Monday	Instruction begins
May 12-15, Wednesday-Saturday	Interscholastic Meet
May 30, Sunday	Memorial Day
June 13, Sunday	Baccalaureate Address
June 14, Monday	Annual Recital of the School of Music
June 15, Tuesday, 10:30 a. m.	Class Day Exercises
June 15, Tuesday, 7:00 p. m.	Annual Alumni Dinner
June 16, Wednesday, 10:30 a. m.	Commencement
June 16-19, Wednesday-Saturday	Examinations

6.

YOU CAN SEE A FUTURE IN FORESTRY

SCHOOL OF FORESTRY

MONTANA STATE UNIVERSITY

Missoula - - - Montana

Original from
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BULLETIN
OF
UNIVERSITY OF MONTANA
MISSOULA, MONTANA

If not delivered, return postage will be sent on notice.

Entered at Missoula, Montana, as second-class matter under Act of Congress, August 24, 1912.

TO Prof Walter Mulford
Berkely
California

Forestry School

Sept. 26
Sept. 2
Nov. 27
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Dec. 19

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FOREST SCHOOL N

Published Monthly by the Forest Club of the School of Forestry of The Univer

VOLUME 2 MISSOULA, MONTANA, NOVEMBER, 1919

"Get Forestry Growth," Says Colonel W. B

Assistant Forester W. B. Greeley in an address before School of Fore the Remedy for Approaching Timber Famine

Assistant Forester W. B. Greeley of the Washington office of the Forest Service recently addressed the School of Forestry in a very interesting lecture on various phases of the nation's forestry problem.

The urgent need of providing for forest growth before our forests are entirely depleted was the keynote of his statements. The assistant forester is the author of several publications on economic phases of the lumber industry. He has just lately returned from military service in France, where he earned the rank of lieutenant colonel of engineers. Colonel Greeley served in the department of construction and forestry of the A. E. F. and returns to this country with the object lesson of European timber famine and the success of their efforts for forest restoration fresh in mind.

COLONEL W. B. GREELEY.

Probably no man in the United States has a better knowledge of economic problems of the nation's timber supply nor a stronger faith in forestry practice as their solution.

"We are approaching more and more nearly," said Mr. Greeley, "the time when we shall be forced to consider fully *the many important phases of the forestry problem; not simply* the forestry
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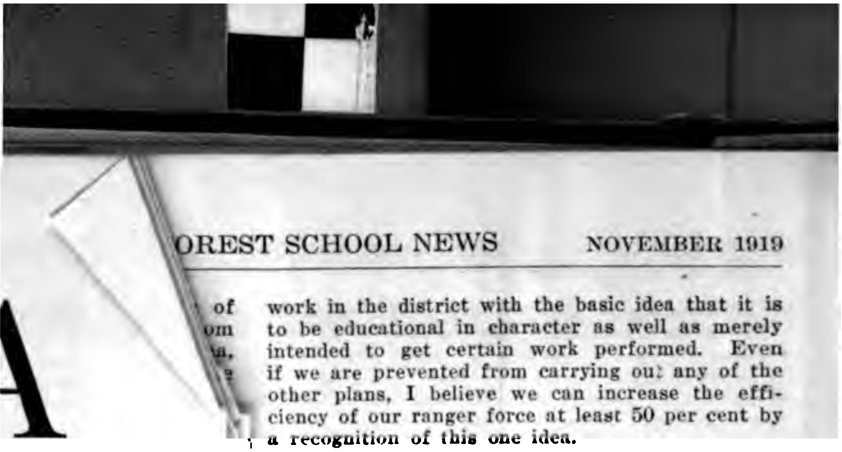

ORESt SCHOOL NEWS NOVEMBER 1919

work in the district with the basic idea that it is to be educational in character as well as merely intended to get certain work performed. Even if we are prevented from carrying out any of the other plans, I believe we can increase the efficiency of our ranger force at least 50 per cent by a recognition of this one idea.

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generally as losses of labor costs, losses of timber materials, or waste of wood, and losses in equipment.

The losses in labor costs are almost always due to laeck of supervision, or improper supervision, and to inadequate check on costs and quantity of log delivery. Such losses are: lost motions and lost time due to uncertainty of workmen; losses due to idleness of workmen; lost motions due to improper routing of work and lack of plans; logs not left in proper position or accessible to next operation; loss of material on which labor has been expended, and small output due to inadequate or poorly fitted tools.

Losses both in timber materials and in labor costs may occur from improper equipment, inadequate maintenance, or failure to keep tools in fit condition. Losses to equipment of saw crews usually occur through poor maintenance or through the outright loss of the tools due to lack of safeguards against loss, or lack or an adequate check on logging equipment.

Losses of timber material, or improper utilization, usually mean also a loss in labor costs because some work or labor expense has usually been expended on it. A lodged tree which is taken down means extra labor costs.

Where management is good and labor is uniformly efficient the costs of falling and log making will vary with a great number of natural factors of the logging chance, which are beyond the control of the operator, or must be modified or overcome in the operation. The principal natural factors which with good management determine the cost of falling and log making are:

world."

"The most obvious phase of the problem is that of the gradual exhaustion of our natice timber."

Mr. Greeley explained to the foresters that various estimates of the amount remaining of standing timber in the United States today credit us with about 2,400 billion board feet of wood suitable for lumber, mining timbers, wood manufactures and general construction purposes. Probably over half as much again, he says, is left us

to the amount *of someti*
cubic feet *every year. A*
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our forests are producting.
"It is obvious," he emp
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The output of the saw crew is shown in M. feet

Logs per M.......	Logs per Tree.......	Slope and Surface.......	White Pine, M. Ft.......	Lodgepole Spruce. Balsam, M. Ft.......	Yellow Pine, M. Ft.......	Larch and Douglas Fir, M. Ft.......
3	4-6	Moderate	13	11-12	11-12	11
		Steep Rough	10	9-10	8-9	8
	7-10	Moderate	14	12-13	13	12
		Steep Rough	10-12	10-11	9-10	9
6	3-5	Moderate	11	10-11	10	9
		Steep Rough	8	7-8	7	6-7
	6-8	Moderate	12	11-12	11	10
		Steep Rough	9	8-9	7-8	7
10	2-4	Moderate	9	9	8-9	7
		Steep Rough	7-8	7	5-6	5
	5-7	Moderate	10	9-10	9	8
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Associated Students' Book Store

COLLEGE
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The Campus Store is strictly an enterprise of the Students of the State University of Montana.

All profits are to be divided between an Annual Rebate Fund and a Capital Fund.

The aim of the management is to place the burden of expense on candy and other luxuries, thus giving the students the lowest possible prices on college supplies.

We handle College Textbooks and Stationery, Candies and Cookies, Toilet Sundries. We do developing and printing, and we sell Pantages tickets for the convenience of the students.

Filson Cruising Shirt

Has six pockets, one of which is a large back pocket 30x21, which makes a complete pack. We manufacture all kinds of clothing for OUT OF DOORS PEOPLE.

UNIVERSITY OF MONTANA

AGRICULTURAL EXPERIMENT STATION
BOZEMAN, MONTANA

MARCH, 1918 CIRCULAR 78

Trees and Shrubs on the Farm

BY
O. B. WHIPPLE, *Horticulturist*
AND
C. C. STARRING, *Assistant Horticulturist*

The people who have but recently made their homes in Montana, especially those on the dry farms of the State, will hardly fail to appreciate the value of trees when looked at purely from the standpoint of pleasure. Some who have lived on Montana farms longer may have become accustomed, in a way, to their surroundings, and the absence of trees no longer causes discontent. They have gradually come to believe that trees and shrubs can not be grown under existing conditions. And possibly there are a few who do not appreciate trees and shrubs. However, as a protection from the glaring sun and drying winds in summer and severe cold in winter, trees and shrubs properly planted and cared for can not but add to the comfort of the home and, to most of us, contribute no little amount of pleasure. But comfort and pleasure are not the only returns the planting of trees and shrubs may bring to those upon the farm.

Note.—The information contained in this circular is presented with the non-irrigated farm uppermost in our mind, for it is on these farms that difficulties are most often experienced in growing trees and shrubs. Many of the suggestions are nevertheless applicable to the irrigated farm and in the later pages will be found some special advice for those who use irrigation water. We feel that the circular will answer well the many demands for information which come from every part of Montana.

There are those who claim that the planting of trees in large numbers upon the plains would greatly modify the climate of these regions, that the rainfall would be increased, and that drying winds would be less frequent. And trees are sometimes planted, even on the dry farm, with a view to financial returns. The wood lot or the shelter belt does, in some cases, furnish fuel for the home and posts for the fences.

Many farm homes have been improved by growing trees under conditions as trying as those found on the dry farms of Montana. It is surely worth a trial. When the matter is summed up, we find that the degree of success is measured largely by the proper selection of plants, proper selection and preparation of soil, and proper planting and care of the trees and shrubs.

SELECTING THE SITE

In many cases the location of the farm home is definitely fixed, the plan is already started and the problem is to complete it, but there is much to be gained in the proper selection of the site. Most of us have more or less positive ideas as to how the farm should be arranged for convenience. Some no doubt give it little thought. Most people prefer to have the house near the highway, and, keeping this one thought in mind, it should otherwise be about centrally located. While it is in some ways convenient to have the house at the cross-roads corner, it may cause a waste of time in going to and from work and in most cases it results in greater difficulty in planning and planting. While not always possible, it is under most conditions more desirable to have a south or east front. If one must have a windbreak to the north and west it is hard to front the house in these directions.

Do not make the mistake of plotting into fields all the tillable land on the farm and leaving the rest for the home grounds. It is impossible to grow trees, shrubs, and especially lawns upon poor soil. An attractive home lot will do more to increase the valuation of the farm than the best ten-acre field on it.

Occasionally there is a limited amount of irrigation water to be had. If possible, locate the home where this may be used on the garden, orchard, and lawn. It will yield greater returns here than on any other part of the farm.

PROTECTING THE HOME GROUNDS

One of the first points to be considered after the selection of the site for the home is that of proper protection of the grounds from your own and your neighbors' stock. Trees and shrubs and garden vegetables planted upon the dry farm can be expected to thrive only when given the best of care and protection. The trees and shrubs may need pruning and the orchard frequent cultivation, but cows and horses are poor pruners and hogs hardly follow approved dry farm practices in such cultivating as they may do.

The fence should be high enough and strong enough to turn all kinds of live stock, with the possible exception of chickens. It should extend around the entire grounds and should be set out far enough to prevent stock from reaching the plants in any way. As a rule the barnyard should be fenced off from the rest of the grounds, especially if stock are allowed any freedom at all about the barns. The one who tends the garden will usually realize the importance of having it fenced, especially as a protection against the chickens. Do not plant your home grounds and then build the fence; build the fence first.

PLANNING THE HOME GROUNDS

Some attention should be given to planning the yard for convenience. The house should be convenient to the orchard, the garden, and the barnyard; but it should be in a yard of its own, separate and distinct from the other portions of the grounds. It should be far enough from the proposed windbreak so the snows which drift inside the shelter will not be annoying about the house. The barns should be located with the same thought in mind. The orchard and the fruit garden should be located where they will be well protected by the windbreak; if they receive the drifting snows, so much the better. Snow is the best protection for small fruits, and, if caught and held within the orchard, supplies much-needed moisture. The entrance may be planned to serve equally well the house and the barn, or, better still, have a front entrance to serve the house and a side entrance to handle the larger part of the travel to the barn.

The house should be located far enough from the road to provide a good foreground—we can not make a good picture without a foreground—and the barn should be far enough from the house to allow for a good back yard and screen of shrubbery between the yard proper and the barnyard. Do not be afraid of setting aside ample land for the home grounds. Five acres, if well planned, is not too much and a smaller space does not allow for good arrangement.

PREPARATION OF LAND

The land to be planted to the home grounds should be well prepared and fallowed at least one year before any attempt is made to start trees and shrubs. The land should be deeply plowed and under most conditions fall plowing is preferable. During the following summer it should be well cultivated to keep down the weeds and conserve the moisture. If it is not practicable to keep the whole yard area cultivated, particular spots chosen for the location of clumps of trees or shrubs may be given a good mulch of straw or coarse stable manure. This will keep down the weed growth and conserve the moisture.

In plowing and working the land, avoid ridging it in places where rows of trees are to stand. On the contrary, the land should be so prepared that the rains will drain toward the newly planted trees. Be sure to cultivate well the area to be occupied by the trees and shrubs, the windbreak, and especially the yard, if an attempt is to be made to grow a lawn. If rows of trees are to be planted on the borders of the yard opposite the windbreak, it will be desirable to plow and summer-fallow strips of land at least ten feet wide here.

SELECTING AND BUYING THE PLANTS

Under such adverse conditions as prevail on our dry farms, it is only natural that one of the most frequent causes of failure is the improper selection of plants. The newcomer brings his ideas with him and attempts to work them out under conditions entirely different from those he is accustomed to. One can not hope for success in growing trees and shrubs unless he has made the proper selection of varieties to begin with. It is no doubt true that there is much yet to be learned about selection of plants for Montana conditions, but observations made in our own State and experiments carried on here and in other States under similar conditions have suggested some of the most promising kinds. Further experiments may lengthen this list.

Many are undecided as to where they should purchase stock. In the first place we may say that it should be bought of a well-established nursery, one that has developed some respect for its reputation. It is also safe to say that the trees should be bought as near home as possible. The local nursery is generally able to furnish kinds adapted to your conditions, and the stock from the nearby nursery has a better chance of reaching you in good condition than that from a distance. If you can not buy your plants near home, it is probably best to try some northern nursery, where varieties adapted to our conditions are more likely to be carried in stock. If the desired variety can not be purchased of the northern nurseryman, one need not hesitate to buy wherever it can be found.

One should buy always a good quality of plants, and under Montana conditions it is best to buy young plants. They are cheaper and more likely to grow. Forest tree seedlings one or two years old may be started more readily than older trees, and such plants are often used in starting windbreaks. Older plants are usually preferred for planting about the yard. A few trees about the house may be set with a little more care and given some water if necessary. Those listed by nurserymen as five to six feet high are a very satisfactory size. Shrubs listed as eighteen to twenty-four inches high are very good for yard planting.

Orders should be placed in early fall for stock to be delivered the following spring. As soon as the trees arrive they should be unpacked and heeled-in in some shady place, as on the north side of a building, or stored in a cool cellar. They should be kept cool to retard the growth of the buds and moist to prevent them from drying out. In heeling-in the trees, dig a trench and set the roots well down in the moist soil and tramp the earth well about them. If the soil is not quite damp, it is best to settle it about the roots with water. If the weather is dry and especially if the trees look rather dry when unpacked, it is best to bury them root and top in moist soil. If everything is in readiness when the trees arrive, they may be planted at once. Should they appear dry, it is best to soak them in fresh water from twelve to twenty-four hours before planting. Trees planted in a shriveled condition are seldom able to revive, while the same trees freshened in soil or water may make a successful growth.

SEASON TO PLANT

Under Montana conditions, trees and shrubs should be planted in early spring, as soon as the native vegetation starts. The young plant must start growth on the food material stored up in its roots, trunk, and branches. If the planting is delayed until the plants have leafed out, this leaf surface generally dries up and the food used in producing it is lost. With its supply of food diminished in this manner, the plant has its chances for surviving reduced proportionately.

HOW TO PLANT

Before setting the plants in the ground, trim off all broken ends of roots; and if any roots are exceptionally long, cut them back to six or eight inches in length. Handle the trees carefully to avoid drying the roots. A good way is to haul them to the field in a barrel with water enough to cover the roots. Take them from the barrel as they are to be planted.

To plant forest tree seedlings or small hedge plants, push the blade of the spade down into the ground and work it back and forth until the roots of the trees may be slipped down behind it. Remove the spade and tramp the soil well down about the roots. If a little water can be poured into the hole before the soil is pressed back about the roots, so much the better. In either case, after the tree is planted and the soil is well packed about the roots, see that the surface soil is loose enough to prevent rapid loss of moisture.

It will pay to plant specimen shade trees and shrubs with a little more care. Dig a good hole and spread the roots out well. In all cases set the plants three or four inches deeper than they stood in the nursery. The tops should be pruned after the trees and shrubs are set. Cut forest tree seedlings back to within a foot or even six inches of the ground. Prune shrubs the same way. On the larger trees remove about one-half of the top. Some of the limbs may be cut out entirely and others cut back one-third of their length. This pruning at planting time should not be neglected for it is very important. Most of the root system has been destroyed in digging and if the entire top is left the remaining root system can not support it and the plant will seldom survive the first summer.

Native plants can often be used to good advantage in beautifying the home. To grow plants from native seed is slow, inconvenient, and unsatisfactory, as well as unnecessary where there are plenty of native seedlings which can be used. Possibly, however, many failures have discouraged some in the use of native stock. If a few principles involved are carefully followed, many places now devoid of trees can be easily made more homelike and attractive. A little attention as to the time of planting, selection of trees, trimming tops and roots, preparation of land, digging holes, filling in dirt around trees, watering, and perhaps shading in the case of evergreens, will go a long way towards success in transplanting these native trees.

In transplanting deciduous trees two important points should be kept in mind. (1) Many native trees, growing unmolested from seed, tend to develop a tap-root system, or at least a coarse, straggling root system. In digging such trees it is difficult to get a root system that is anywhere nearly proportioned to the top, and the older the tree the more difficult is the problem. Large nursery-grown trees are handled more easily for the simple reason that they have been transplanted one or more times and have developed a compact and more fibrous root system. In planting these native trees, therefore, it is well to remember that small trees should be chosen and by selecting those that grow in good soil rather than on rocky hillsides we are pretty sure to get a root system that will stand transplanting better. (2) Native trees, especially when growing in thick clumps, protect each other. Such trees can not be expected to survive a sudden transition to open exposure on the prairies. Losses from this cause can be minimized by selecting specimens growing by themselves, or by first moving them to nursery rows where they can be grown close together for two or three years. They will thus be gradually adapted to exposed conditions and the survivors will be suited for planting in permanent positons. Of course where a great many trees are planted close together as in a windbreak they afford each other more or less protection.

Greater care is necessary in handling evergreens as they are in leaf all the time and will not stand neglect. The roots should not be exposed at all to the air. If it is not possible to dig trees with a ball of earth attached, the roots should be dipped in mud and wrapped to prevent drying. Small trees twelve to fifteen inches high should be selected and planted in small beds where they may be given partial shade. Satisfactory shade may be provided by a brush or lath screen placed twelve or eighteen inches above the tops of the trees. A good screen may be made by nailing laths on a frame of any convenient shape, leaving openings about an inch wide between the laths. The trees may be planted rather close together but not close enough to crowd in the next two years. After two years they may be moved to the nursery row where they should grow two or three years before they are moved to the permanent location. Even then it is a good plan to plant them rather closely for mutual protection or to plant them among deciduous trees, thinning out the latter as the evergreens grow. If planted thickly, some of the evergreens will need to be thinned out later. If handled as suggested for transplanting large trees, those thinned out can often be used in other places. Evergreens should be moved early in the spring just as the buds open. Patience is necessary but the reward is more than sufficient. Single trees twenty-four to thirty inches high may often be moved from the timber to the yard if carefully dug and planted, and shaded for two or three years with a lattice screen.

Details given elsewhere for setting out trees apply equally well here. Deciduous trees from the woods should be more severely top pruned when first set out than those from nurseries. Evergreens are usually not pruned when moved but it is well to watch for double leaders and cut one out.

MOVING LARGE TREES

Rather large trees, if they have been transplanted once while young, are often successfully moved. In such cases it is best to dig a trench around the tree in the fall. This trench should be three feet deep and several feet from the base of the tree. The ball of earth thus marked out can be partly severed from the earth beneath. The trench can be filled with straw or similar material and the ball of earth left to freeze. Before the ground thaws out the following spring the straw is removed and the tree with the frozen earth moved to its new location. The hole to receive the tree must be prepared in the fall and kept from freezing by filling with straw or coarse manure. It is a good plan to move just as much earth as possible with the tree. Evergreens up to six or eight feet in height may be moved in this manner. The ball of earth should have a diameter of at least two-thirds the height of the tree. Even trees moved in this way should be shaded for one or two summers.

CULTIVATION

During the first summer the windbreak, the rows of shade trees, and the hedges should receive good, clean cultivation. Individual plants or clumps that can not well be cultivated may be mulched with straw or coarse stable manure. The windbreak should be cultivated as long as it is possible to go between the trees.

It may be well to mulch the soil about young trees and shrubs for the first winter at least. If mice are inclined to be troublesome, the mulch should not extend up to the trunks of the trees. To prevent injury by mice, pile a cone of earth eight inches high about the base of the tree and then mulch outside of this.

PRUNING

The object of pruning is to keep trees and shrubs in a good state of health and vigor. To this end we try to assist rather than change their natural habits of growth. To become proficient one should learn (1) what to remove, (2) when to prune, and (3) how to make proper cuts.

What to remove from trees.—Diseased and dead parts should be removed. This is preferably done as soon as noticed, although most of such work may be done early in the spring, as noted later on. If two branches rub, one should generally be taken out, although cases may arise where it is desirable to head back one of them below the place where it rubs. On lawns where high-headed trees are desirable, trees should not be allowed to branch close to the ground. As the tree grows, the lower branches should be pruned off; at least they should not be allowed to grow very large. Where trees are exposed it is often desirable to allow small branches to grow rather low for a season or two as a protection to the trunk. The branches should be kept as small as possible by severe heading back, say to two or three buds, and they should be taken off before they get very large.

What to remove from shrubs and bushes.—Dead and diseased parts should be removed. Caragana, honeysuckles, Russian olive, and some others will stand rather severe heading back if it is desirable to keep them low. Sometimes it is necessary to thin out some of the wood when it gets too thick. Death of branches in the center of bushes or a spindling growth of these branches usually indicates that the bushes are too thick. In any case it is well to remember that moderate annual prunings are better than spasmodic severe prunings. The latter often means the removal of large limbs. This should be avoided as much as possible.

When to prune.—It is best to prune trees and shrubs early in the spring before growth starts. Shrubs which bloom very early in the spring are often pruned after the blooming season or in early summer. In our dry climate pruning in the fall or early winter is not a good practice. Dead wood of course is unsightly and may be removed at any time.

How to make proper cuts.—In heading back a branch, cut to a bud or to a lateral branch. When large branches are headed back to laterals, the latter take up much of the excess sap and prevent the formation of many water-sprouts. In cutting off side branches, cut them close to or flush with the surface of the branch from which they arise. Do not leave stubs. If cut properly the wound may be a little larger than when a stub is left, but it will heal more quickly.

It is generally advisable to paint wounds which are two inches or more in diameter. For this purpose a good grade of white lead paint is one of the best dressings. This paint should be thick and should not be applied in excess as it may run down over the bark and injure it.

THE WINDBREAK

The purpose of the windbreak is one of protection. It should protect the buildings and the fruit and vegetable gardens from sweeping winds. In winter it should stop the blowing snow and prevent it from piling up about the buildings. Such protection adds much to the comfort of the home, and without some such protection from drying winds it is almost useless to attempt to grow fruit upon the dry farm. In summer the windbreak checks the winds which rob the soils of the garden, orchard, and yard of their moisture. If it is to serve these purposes it must be dense enough and wide enough to stop the wind. To make it dense, it must be made up of trees of varying habits of growth. A grove of cottonwoods will not serve the purpose, as the lower limbs soon die off and allow the wind to rush through underneath. Nor will a grove of low-growing shrubs serve all the purposes of a windbreak. It must *be a combination* of the two. The width should be from fifty to one hundred feet, or even wider, depending upon the force of the winds.

In most sections of Montana east of the divide, the troublesome winds are largely from the north and west. This means that the home grounds must be protected at least on these two sides. The windbreak should be far enough from the buildings so the snow which collects inside will not be annoying. With a properly constructed break one hundred feet is probably a safe distance. The planting should be so arranged that the snow will collect among the trees as much as possible. To encourage this the smaller trees and shrubs should be planted to the windward and the others arranged in order of height with the taller ones inside. A desirable windbreak is made up of one row of Siberian pea tree on the north and west, one row of box elder next, then two rows of box elder and green ash mixed, and on the inside two rows of poplar or cottonwood. The drifting snows should pile up within this grove and greatly increase the moisture supply.

For making a windbreak the most promising trees are the Canadian poplar, native cottonwood, box elder, golden Russian willow, green ash, white elm, and Siberian pea tree. The Canadian poplar (*Populus balsamifera*) is one of the hardiest of the poplars. It is a rapid grower and lasts well. The common, narrow-leafed cottonwood found growing along the streams in the eastern part of the State may be used for the windbreak or the yard. It is probably not so rapid a grower as the Canadian poplar and does not last as well. It should not be used when the poplar can be secured. The box elder is also a native of the State and will thrive under most conditions. It is a tree of rather straggling habit, grows rapidly, and thrives well in the windbreak as a tree of intermediate growth. The golden Russian willow will succeed on good soil with a little more than the average rainfall. It makes a rapid, dense growth, may be trimmed low, and where the conditions are favorable it is an excellent tree for either the outside or the second row in the windbreak. The green ash is found growing along the streams of eastern Montana. With good care it may be induced to grow on the dry farm, especially when planted in groves. It is not so rapid a grower as the other trees mentioned, but it is a more permanent tree. For this reason it is well to alternate this tree in rows with the box elder and poplar, with the idea of removing the shorter-lived trees as they begin to crowd. The white elm thrives in some sections of Montana. Where the growing season is not too short and where the rainfall is a little above the average, the elm may work out well as a windbreak tree. It is long-lived and may be alternated in the rows with poplars as it grows quite slowly at first. The Siberian pea tree is one of the hardiest plants available for windbreak purposes. It is a small shrub, rarely growing over fifteen feet high. It makes a low, compact growth, and for that reason makes a first-class tree for the outer rows. It should be used in preference to the golden Russian willow where there is doubt as to the willow's being adapted to the conditions.

Of course, the evergreens are not so promising for the dry farm. Yet after they become established they resist drought and severe weather even better than some of the trees just mentioned, and they would surely make ideal windbreaks. It is possible that after a shade is once produced the bull pine may be started among the other trees. Attempts should be made to start only small specimens, those not over a foot high.

In arranging the windbreak the rows of trees should be placed from eight to ten feet apart, with the trees from four to eight feet apart in the rows. The trees in the outside rows may be planted as close as four feet, while permanent trees should stand eight feet apart. Where the ash and box elder are planted alternately, set the ash eight feet apart with a box elder between.

PLANNING AND PLANTING THE YARD

The planning of the yard should have the same careful consideration as does the planning of the home. Not only the convenience of the place but especially its attractiveness depends upon proper planning and planting. Considered from the standpoint of beauty alone, the yard may be planted by the same rules as those which the artist follows in painting a landscape. For after all the yard is to become a picture or a series of pictures, good or bad, depending upon the skill displayed in planning it. The artist would not paint a home scene with the house the foremost figure. He would not picture the entrance to the grounds as a straight lane terminating at the door of the barn, giving an unobstructed view of barnyard scenes, which are at best seldom attractive. Nor would he bound the yard by four lines of trees or shrubs, with no attempt to break the monotony by filling in the corners and planting here and there a clump of shrubs to break up the straight lines. So we should apply these rules to the planting of the home yard and make the house the central figure but not the foremost. The trees and shrubs should come to the foreground at the sides of the picture. Trees may be planted along the front border of the lawn, provided they are pruned up enough from below to give a good view of the yard from the highway. Hedges are more often used to screen unsightly portions of the home grounds, and unless one is ashamed of the front yard they should seldom be tolerated as a front-yard fence.

If the yard is small and there is no place for curved drives, the lane should at least make a slight curve after it passes the house; then a few trees and shrubs properly placed will screen the barnyard from the entrance to the grounds. If necessary to plant windbreaks made up of trees and shrubs planted in straight lines, the picture may be greatly improved by filling in the square corners with smaller shrubs and by planting clumps of shrubbery here and there inside the windbreak where it borders the yard proper. Small shrubs may be planted about the house to unite the house more or less with the lawn and to break up the straight lines. They should be used to fill in all retreating angles about the foundation of the house. Shrubs to be planted about the house should be selected and located with some care. In the first place they should be largely low-growing varieties. So long as it does not cover a window or crowd a doorway, a tall shrub like the lilac or honeysuckle may occasionally be used in some deep retreating angle about the house. Avoid planting trees and shrubs in places where they obstruct views from windows. If clumps of trees are planted about the yard, a few low shrubs planted near them will have the effect of finishing the picture.

A screen of shrubbery should separate the barnyard from the yard proper. This should be far enough from the house to give a roomy back yard which may serve as a children's playground, clothes-yard, etc.

A row of trees may border the lawn on the two sides opposite the windbreak. They should not be low-growing trees, however. Remember that at least from some points along the highway one should get a clear view of the lawn and of most of the house. If the yard is large, clumps of trees or even single trees may be scattered about the front and back yards. In planting trees and shrubs about the home it is in most cases desirable not to mix the planting too much. In other words, group together in one part of the yard a few lilacs, in another corner a few honeysuckles, etc. A clump of five lilacs with a background of other shrubs looks better than a clump made up of five different kinds of plants. Avoid crowding the yard full of trees and shrubs. Leave a goodly portion of open lawn. If the yard is small, one tree with a few shrubs about it will look better than a group of five trees with the additional shrubbery which would crowd the lawn.

The shrubs used in the yard must be selected from a rather limited list. The Russian olive may be pressed into service as a yard shrub. It makes a very good appearance when used in masses about the border, as a hedge, or as a screen. Two forms of the Siberian pea tree (*Caragana arborescens* and *Caragana frutescens*) are among the hardiest shrubs. The first mentioned grows to a height of fifteen feet, but it is useful as a shrub to be planted in masses or in hedges and screens. It takes several years to reach this height, and as it will stand severe pruning it may be kept down quite low. The other is a smaller shrub which grows into more graceful specimens. It is a useful shrub to plant about the house or about clumps of trees upon the lawn. Both forms produce rather showy yellow flowers.

The common lilac succeeds very well in trying locations. It may be used as a hedge plant in the screen or as specimen plants about the lawn. It grows into a graceful shrub or high hedge with little pruning. The Tartarian honeysuckle should thrive under dry farm conditions. It grows to a height of ten feet and forms a very graceful specimen plant with small but fragrant blossoms. It is a good plant for high hedges or screens or for filling in corners about the border of the yard. The buckthorn is another desirable shrub for hedges or screens. It stands pruning well and will make a stock-proof hedge. It should prove hardy under most conditions. Any of the taller-growing trees suggested for the windbreak may be used in the yard.

SPECIAL SUGGESTIONS FOR THE IRRIGATED FARM

Much of the information given in the foregoing pages will apply equally well to the irrigated or the non-irrigated farm. The choice of plants, time of planting, plan of planting, cultivation, pruning, etc., will be much the same in either case. However, a few suggestions particularly applicable to the growing of trees under irrigation may be helpful. Disappointments in tree culture come not alone to those who are denied the use of irrigation water. Many failures are experienced on irrigated farms and in many cases these failures may be attributed to wrong methods of irrigation. A simple statement of some of the principles underlying the use of water in growing trees seems desirable.

On the irrigated farm good soil preparation is important but not necessarily as long a process as on the non-irrigated farm. Summer fallowing is not necessary. Fall plowing is to be preferred. If plowed in the spring the land must be well worked down with a disk or packer for water can not be handled economically or satisfactorily on loose soil. It is seldom wise to attempt to start trees on newly broken sod land, even when water is available, unless the sod is exceptionally well cut up in the process of preparation.

Setting trees with water.—In setting trees with water, a hole should be dug large enough to accommodate the roots without crowding. If rows of trees are to be set and running water is available, a good plan is to plow out a furrow and dig the holes in the bottom of this. Place the tree in the hole, cover the roots well with earth, and turn water into the furrow to settle the soil covering the roots. Whether run in furrows or poured into individual holes, enough water should be used to thoroughly settle the soil about the roots. After the water has soaked away, the furrow and holes are filled with loose earth, which should not be packed. Always remember that it is wise to use plenty of water at the time the plants are set.

Irrigating trees and shrubs.—(1) Newly planted trees do not need frequent irrigation early in the season. The roots are not capable of taking up a great amount of moisture and too frequent watering retards growth by keeping the soil cool. Water the plants well at the time they are set and then withhold water until examination of the soil shows that the subsoil is really drying out. If the surface soil is kept well stirred about the plants, this first watering should last from three to five weeks, depending upon the nature of the soil and the weather. (2) The soil should be thoroughly soaked when the trees are watered. Frequent light irrigations encourage shallow rooting and really retard growth. Rows of trees are best watered by plowing a furrow on either side of the row. The first year these furrows should be from twelve to eighteen inches from the trunks of the trees. As the trees grow older the furrows may be moved a little farther away from the trees and increased in number. Remember that the spread of roots is somewhat greater than the spread of tops and that irrigation furrows should supply moisture to as much of the surface area as roots occupy. (3) Trees should not be irrigated late in the growing season. This encourages them to grow late in the fall and immature plants are more susceptible to winter-killing. Trees that are well ripened will stand much lower temperatures than those that keep on growing till late in the season. In most cases it is not wise to irrigate young trees later than the middle of August. If the soil holds water well, the first of August might be better. (4) Watering trees after the first frosts in the fall is sometimes a good plan, especially where the winters are very dry. A good supply of moisture in the soil during the winter lessens the danger of winter-killing.

SOME DESIRABLE SHRUBS TO USE

Barberry.—Unfortunately the common barberry and the purple-leaved variety are hosts for one stage of the stem rust of wheat. None should therefore be planted in the State and those that have been planted should be removed.

Barberry, Dwarf, (*Berberis Thunbergii*) is a dwarf barberry growing 2 to 4 feet high; green foliage; yellow flowers in late spring; red berries and foliage in fall. This should be protected during the winter as it is not fully hardy, especially when young. As the plants become older they endure winters better. This species does not harbor the wheat rust as does the common form.

Barberry, Common, (Berberis vulgaris) attains a height of 4 to 6 feet; foliage green; flowers in clusters borne in late spring; desirable also for its red fruit and foliage in the fall. **Harbors wheat rust.**

Barberry, Purple, (B. vulgaris, var. atropurpurea) is similar to the common green barberry in habits of growth but the foliage is a rich purple instead of green. **Harbors wheat rust.**

Buckthorn (*Rhamnus cathartica*) is a desirable hedge plant, 10 to 12 feet high; bears black berries in the fall.

Buckthorn, Sea, (*Hippophae rhamnoides*) grows about 8 feet high and resembles buffalo berry. The leaves are gray-green above and silver-green below. It bears yellow flowers in the summer, followed by orange-yellow berries in the fall, which hang on well into winter.

Buffalo Berry (*Shepherdia argentea*) grows 10 to 15 feet high. The leaves are narrow and silvery in appearance. It bears yellow flowers in early summer and red or yellow fruit in the fall. The berries are used in making jellies.

Chokeberry (*Sorbus arbutifolia*) belongs to the mountain ash group of trees and shrubs. It grows 6 to 12 feet high and is hardy at Bozeman.

Choke-Cherry (*Prunus Virginiana*) is native to most parts of Montana. It is easily transplanted and makes a desirable ornamental plant, especially in shrubbery groups.

Crab, Siberian, (*Pyrus baccata*) grows 15 to 20 feet high and bears fragrant flowers in the spring. The red fruits are very small, about like a good-sized pea. It is susceptible to blight and should not be planted in fruit-growing sections.

Currant, Golden or Flowering, (*Ribes aureum*) grows 6 to 8 feet high. It bears an abundance of bright yellow, fragrant flowers in the spring and black berries in the fall. It is desirable for shady locations.

Dogwoods (*Cornus*) are chiefly valued in shrubbery because of the green foliage during the summer and bright red colors of the twigs and branches during the winter. There are several species native to Montana that are ornamental and hardy under cultivation. Siberian dogwood (*C. alba* var. *Sibirica*) has proved hardy on the station grounds at Bozeman.

Hawthorn (*Crataegus Douglasi*).—Black haw is similar to scarlet thorn in height and color of flowers but the fruits are black. It is native to Montana.

Hawthorn (*C. coccinea*).—Scarlet thorn is a shrub growing 15 to 20 feet high, with apple-like blossoms in the spring, bright green foliage in summer, and red berries in the fall. It is hardy and will make a vigorous growth on rich, moist land.

Honeysuckle, Tartarian, (*Lonicera Tatarica*).—This shrub grows to a height of 10 feet. The flowers are pink, crimson, or white. The fruits are mostly red, though some bear yellow fruits. It is a native of Russia and Siberia and has proved hardy at this station.

Lilac, Purple, (*Syringa vulgaris* var. *purpurea*).—Though this plant is common in nearly all parts of the State it is none the less desirable for planting as its beautiful, fragrant flowers,dense foliage, readiness of growth, and variable habits make it well suited for shrubberies, ornamental hedges, or specimen plants.

Lilac, White, (*S. vulgaris* var. *alba*).—This variety should become more prominent as the white flowers make a pleasing contrast with the purple lilac. It is as hardy as the latter and blossoms profusely.

Pea Tree (*Caragana frutescens*) grows 5 to 6 feet high and bears yellow flowers in late spring or early summer. It is hardy at Bozeman.

Pea Tree, Siberian, (*C. arborescens*) grows 12 to 20 feet high and is entirely hardy. The flowers are pea-like in form, yellow in color, and produced in great abundance in late spring or early summer. The bark of the young wood is bright green.

Rose, Harrison's Yellow, (*Rosa hemisphearica* var. *Harisoni*) grows to a height of 6 feet or more. It is very hardy and bears bright yellow, double flowers in late spring or early summer.

Rose (*Rosa rugosa*).—There are two Russian types and a Japanese type. The former are considered hardier than the latter and are recommended for planting. So far we have tested only the Japanese type at Bozeman, where it has proved hardy. It grows from 4 to 6 feet high. The leaves are a very dark, glossy green. The flowers, single or semi-double, range from red to white and are two to three and one-half inches across. It is valuable for shrubberies or single specimens.

Sea Buckthorn.—See under Buckthorn.

Service Berry, Western, (*Amelanchier alnifolia*) is native to *Montana, hardy,* and desirable for shrubberies. It is valued for its white flowers in the spring and dark purple berries in the late summer and fall.

Snowberry (*Symphoricarpos racemosus*) is native to the State and does well under cultivation. It grows about 4 feet high. Small pink flowers are followed by large white berries which hang on well into winter.

Spiraea Van Houttei grows 5 or 6 feet high and is one of our best ornamentals. It is almost hardy and when given slight winter protection will not kill enough to interfere with growth or flowering.

DECIDUOUS TREES

Ash, Green, (*Fraxinus lanceolata*) is native to the eastern part of the State along the Yellowstone and lower Milk River valleys. There it grows from 20 to 50 feet high and when brought under cultivation makes a desirable tree for ornamental and windbreak purposes. It is hardy in most parts of the State and will endure considerable drought.

Ash, White, (*Fraxinus Americana*).—These trees, when 5 to 8 feet high, if not cultivated late in the season, appear to be hardy at this altitude (Bozeman) and may be recommended for planting. At lower altitudes in the State the white ash promises to be hardy at all stages of growth and should afford a good tree for street and park planting.

Birch, European White, (*Betula alba*) sometimes grows to a height of 80 feet. The bark on the trunk and larger branches is white. It is hardy and excellent where only partial shade is desired. It is not suitable for street planting.

Birch, Cutleaved Weeping, (*B. alba* var. *pendula laciniata*) has whiter bark than the European birch and long drooping branches. It is one of our most graceful and ornamental trees and is entirely hardy.

Box Elder (*Acer Negundo*) grows about 60 feet in height. It is valuable for shelter belts as it adapts itself to many adverse conditions. It is hardy and is adapted to all parts of the State where irrigation water is available but does not stand drought very well. It is not desirable for lawns where other trees can be grown because of its low, spreading habit, the ease with which it is broken by snow or wind and the insects which infest it. It is not a good street tree.

Elm, White, (*Ulmus Americana*) is hardy at the lower altitudes of the State and is a desirable tree for street and home ground planting. At higher altitudes with a short growing season it is not hardy. It requires a rather moist soil.

Larch (*Larix Americana*) is a desirable ornamental, growing to a height of 60 feet. It is hardy at Bozeman but is a doubtful tree for the prairies unless irrigation water is available.

Larch (*Larix occidentalis*) is native to the western part of the State and is hardy at Bozeman. It grows to a height of 150 feet. As the larches generally do better in moist soil, this tree is of doubtful value without irrigation.

Locust, Black, (*Robinia pseudacacia*) has pinnate leaves. The flowers are pea-like in form and the seeds are borne in pods. It grows 60 to 80 feet high. At Bozeman the tree is not hardy. At lower altitudes in the State with a longer growing season it can be grown.

Maple, Manchurian, (*Acer Ginnala*) is a small tree 20 feet high. The leaves turn red in the fall, making it desirable in shrubberies for autumn effects. At lower altitudes it is hardy. At higher altitudes it kills back when young but seems hardy as it grows older.

Maple, Norway, (*A. platanoides*) grows to 100 feet. It is a beautiful tree with a round symmetrical head producing dense shade. It does not grow as rapidly as the soft maple and has a tendency to form branches near the ground, which sometimes makes it undesirable as a street tree. At lower altitudes than Bozeman it is hardy. At Bozeman the greatest injury generally comes the first year after setting out. After that the injury is not sufficient to warrant discarding it from our list of trees.

Maple, Silver or Soft, (*A. saccharinum*) grows 120 feet high and is one of the fastest growing maples. The leaves are 4 to 6 inches long and deeply lobed, and are silvery on the under side. It grows best in rich, moist soils. It is not hardy enough to warrant planting at high altitudes. At lower altitudes than Bozeman, where the growing season is longer, the soft maple makes a desirable shade and street tree. Weir's cut-leaved maple is an improved variety of the soft maple and seems to be hardier than the others. It has deeper-lobed leaves and more drooping branches. At lower altitudes it will make a desirable ornamental tree.

Maple, Tartarian, (*A. Tataricum*) is a small tree or shrub growing 20 feet high. It is desirable for groups and shrubberies. It can be grown in any part of the State where the soil is fertile and irrigation water available.

Mountain Ash (*Sorbus Aucuparia*) grows into a round-headed tree from 20 to 40 feet high. It is hardy and desirable for its foliage and conspicuous red berries in the fall. The trunk of the tree is more or less subject to sun-scald on the south side during the winter and should be shaded at this season for four or five years.

Mountain Ash (*S. Americana*) is similar to the above. It is hardy and desirable for ornamental purposes.

Mountain Ash, Western, (*A. sambucifolia*) is native to Montana and grows into a small tree or shrub.

Oak, Bur, (*Quercus macrocarpa*) is native in parts of Montana where it is known as the scrub oak. It does not grow over 40 feet high. It is hardy but very slow-growing and not desirable as a street or shade tree because of its slow growth and small size.

Plums.—Some of the native plums are desirable in groups of shrubbery. Seeds of the same can be stratified in the fall and planted out in the spring, or they may be planted in the nursery row in the fall, in either case not allowing the seeds to dry out. They should be transplanted once in the nursery row before setting them in a permanent location.

Poplar, Balsam, (*Populus balsamifera*) is hardy and desirable for street planting. The wood matures early and the leaves drop before freezing weather. It is one of the best poplars. A variety (*latifolia*) of this poplar is very hardy and promises to be desirable for street and general planting.

Poplar, Certinensis, (*P. laurifolia*) is a rapidly growing, hardy tree. It is similar to the Carolina poplar in form of top. At this station it has given the best results of any of the poplars and promises to be good for street and ornamental planting.

Russian Olive or **Oleaster** (*Elaeagnus angustifolia*) is a small tree or shrub 20 feet high. The stems are usually spiny, the leaves lanceolate, light green above and silvery white below. It is suitable for hedges, screens, windbreaks, and groups. It endures considerable drought and alkali.

Willow, Diamond, (*Salix vestita*) is native to Montana and is hardy. It is considered valuable for fence-post material.

Willow, Golden, (*S. vitellina*) is hardy. It does not give a dense shade and the leaves and small branches fall throughout the summer, which makes it undesirable for a street and shade tree.

Willow, Laurel-Leaved, (*S. pentandra*) has glossy dark-green leaves. It is desirable for producing quick effects in shrubbery groups. It is more adapted to dry weather than other willows.

Willow, Russian Golden, (*S. vitellina*, var. *aurea*), has golden yellow bark and is superior to the common golden willow, with which it should not be confused. The young twigs have a reddish cast in the fall.

Willow, White or **Gray,** (*S. alba*) has not been tested at the higher altitudes of the State. It is considered a desirable tree for windbreaks on the prairies of North Dakota and will no doubt prove suitable for the prairies having climatic conditions similar to those of that State.

EVERGREENS

Arbor Vitae, Common, (*Thuya occidentalis*) has broad, scale-like leaves. It is adapted to evergreen hedges where there is plenty of irrigation water and no alkali in the soil.

Cedar, Red, (*Juniperus Virginiana*) is one of the largest junipers, sometimes reaching 100 feet. Native forms and most of the cultivated varieties are entirely hardy. Where it thrives it makes a desirable tree, but at Bozeman the growth is so slow that it seems advisable to plant it only where a large assortment of trees is desired. The junipers have more or less scale-like leaves, inconspicuous flowers, and berry-like fruits.

Pine, Austrian, (*Pinus Austriaca*) grows 40 to 50 feet high. It is hardy but does not seem adapted to open exposures like the Scotch pine.

Pine, Dwarf Mountain, (*P. montana*, var. *Mughus*) is a dwarf pine desirable in ornamental evergreen groups.

Pine, Jack, (*P. divaricata*) has not been tested on the station grounds at Bozeman. It has proved hardy in the Dakotas and should prove satisfactory in this State where the altitude is not too high. It does well on dry, poor lands.

Pine, Scotch, (*P. sylvestris*) is native to Europe and has proved hardy at this station. It is a desirable tree where irrigation water is available.

Pine, Western Yellow or **Bull,** (*P. ponderosa*, var. *scopulorum*) is hardy and a desirable tree, especially for shelter belts. It does well on dry soils.

Spruce, Colorado Blue, (*Picea pungens*) grows 80 to 100 feet high and has bluish-green to silver-white leaves. It is hardy and is one of our best ornamentals.

Spruce, Engelmann, (*P. Engelmanni*) is a desirable ornamental, growing 150 feet high. It is native to Montana. It is hardy and good for group planting on lawns and for shelter belts or windbreaks.

Spruce, Norway, (*P. excelsa*) is a very good tree for windbreaks. On the Dakota prairies, however, it has not proved as satisfactory as the Black Hills spruce and under similar conditions in this State it will probably be best to plant the latter. Young Norway spruce trees have not proved to be fully hardy at Bozeman but promise to be hardy when acclimated.

Spruce, White, (*P. alba*) is a valuable ornamental evergreen as it develops a good conical shape and does well on a variety of soils. The Black Hills spruce is a form of the white spruce that is adapted to the prairies of the Dakotas and should prove satisfactory on the prairies of Montana with similar climate. It is slower in growth, more stocky, and the needles are darker than the white spruce.

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UNIVERSITY OF MONTANA BULLETIN
STATE UNIVERSITY SERIES NUMBER 265

STATE UNIVERSITY
MISSOULA, MONTANA

The School of Forestry

ANNOUNCEMENTS FOR
1924-1925

JULY, 1924

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THE UNIVERSITY OF MONTANA

Melvin A. Brannon, Chancellor of the University

The University of Montana is constituted under the provisions of Chapter 92 of the Laws of the Thirteenth Legislative Assembly, approved March 14, 1913 (effective July 1, 1913).

The general control and supervision of the University are vested in the State Board of Education. The Chancellor of the University is the chief executive officer. For each of the component institutions there is a local executive board.

Montana State Board of Education

Joseph M. Dixon, Governor..Ex-Officio, President

Wellington D. Rankin, Attorney General....................Ex-Officio

May Trumper, Supt. of Public Instruction..................Ex-Officio, Secretary

John Dietrich	(1925)	Charles H. Foot	(1927)
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J. H. T. Ryman	(1926)	J. W. Freeman	(1928)
Sydney Sanner	(1926)	R. Emmett Brown	(1928)

The University comprises the following institutions, schools and departments:

The State University, Missoula

Established February 17, 1893, and consisting of

The College of Arts and Sciences
The School of Law
The School of Pharmacy
The School of Forestry
The School of Journalism
The School of Music
The School of Business Administration
The Summer Quarter
The Biological Station (Flathead Lake)
The Public Service Division
The Graduate Division

Charles H. Clapp, President

The State College, Bozeman

Established February 16, 1893, and consisting of

The College of Agriculture
The College of Engineering
The College of Applied Science
The College of Household and Industrial Arts
The School of Music
The Summer Quarter
The Secondary School of Agriculture
The Agricultural Experiment Station
The Agricultural Extension Service

Alfred Atkinson, President

The State School of Mines, Butte

Established February 17, 1893

Course in Mining Engineering
Course in Metallurgical Engineering
Bureau of Mines and Metallurgy

George W. Craven, President

The State Normal College, Dillon

Established February 23, 1893, and consisting of

The Two-years' Course
The Summer Quarter
The Teachers' Service Division

Sheldon E. Davis, President

For publications and detailed information concerning the different schools and colleges address the president of the particular institution concerned. Communications intended for the Chancellor of the University should be addressed to the State Capitol, Helena, Montana.

School of Forestry

PROFESSORS, DORR SKEELS, T. C. SPAULDING (Acting Dean). ASSISTANT PROFESSOR, FAY G. CLARK. INSTRUCTORS, ARNOLD E. BOREL, JEROME H. RAMSKILL.

The instructional work of the School of Forestry is along three distinct lines:

1. An undergraduate course of four years providing for specialization in the various branches of Forestry or Forest Engineering.

2. A graduate coures leading to the degree of Master of Science in Forestry. Open only to those having exceptional qualifications.

3. A Short Course for field men. Open to a limited number of students and covering a twelve weeks period in January, February and March of each year.

The undergraduate courses are arranged to train men for the various branches of scientific and administrative work with the government's forest service or with lumber companies and timber-owning corporations. The work is arranged to allow for specialization in Forest Engineering, Silviculture and Forest Management or Grazing Management.

Graduate training, leading to the degree of Master of Science, is offered in Silviculture and Forest Management.

The ranger school is organized for the special purpose of training men already in woods work to do better service in forestry and lumbering. Distinctly, it is not a course for inexperienced men.

A forestry club with a student and faculty membership of more than 100 meets fortnightly for the discussion of forestry problems, the consideration of technical and professional papers and the promotion of a social spirit.

Advisory Board

At the annual meeting of the Pacific Coast Logging Congress in 1917 it was proposed to create an Advisory Board for each of the Forestry Schools in the western states. This board was to consist of prominent lumbermen and members of the U. S. Forest Service, who would actively work with the faculty of the Schools of Forestry in formulating policies best adapted to provide an adequate training for the student and cooperation in the solution of the State's forestry problems. The State Board of Education authorized, in December, 1917, the creation of a board representing the lumbering interests and forest activities to cooperate with the officers of the School of Forestry.

The advisory board of the School of Forestry consists of the following members: Kenneth Ross, General Manager Lumber Department, Anaconda Copper Mining Company, Bonner, Montana; W. R. Ballard, General Manager, Somers Lumber Company, Somers, Montana; Fred Morrell, District Forester, District 1, U. S. F. S., Missoula, Montana; E. G. Polleys, Polleys Lumber Company, Missoula, Montana.

Advantageous Location

The Montana School of Forestry possesses marked advantages in the matter of location and equipment. Every forest type of the inland northwest is found within a few miles of the school. Two transcontinental railroads, three branch railroads and interurban electric lines place the school within easy reach of extensive logging, lumbering and lumber manufacturing operations. Three large mills are located within thirty minutes ride or walk from the campus. All have placed their plants at the use of the School of Forestry for laboratory purposes.

Pinchot Hall, the new home of the Forest School, is one of the finest buildings on the campus. It is a reinforced concrete, tapestry brick and terra cotta structure, 60x130 feet, three stories in height, exclusive of the basement, which contains only the thoroughly modern pumping and ventilation machinery. The first floor is devoted to the well-equipped Library and Forest Club Rooms, the School Offices, the offices and headquarters of the State Forester of Montana, the laboratories in Forest Utilization, the instrument room, the shower and locker room and one lecture room. On the second floor, reached by broad terraza stairways, are located the laboratories in Fire Protection and Forest Improvements, Grazing, Silviculture and Forest Mensuration. Here also is the auditorium with a seating capacity of 200. The moving picture and stereoptican booth is located at the rear of the assembly room on a stair landing between second and third floors. The third floor is devoted to Forest Engineering with its class rooms, dark room, blue print room, four drafting and engineering laboratories and the supply room. Faculty members have their offices adjacent to their laboratories.

The headquarters of District 1 of the United States Forest Service and the offices of two forest supervisors are located in Missoula. The boundaries of the Lo Lo, Bitter Root and Missoula National Forests and Blackfeet Forest Protective Association are closely adjacent to the school. They include more than 4,000,000 acres of government and privately owned timber lands, under forestry management. Within 50 miles of the school are the boundaries of nine national forests and two other government timber reserves. Within 100 miles are the boundaries of seventeen national forests, three other government timber reserves and a national park. The offices and headquarters of the State Forester of Montana and the State Forestry organization are located in Pinchot Hall.

Summer Work

One of the most important features of the School of Forestry is the opportunity which the students have for summer work. Each student is expected to spend not less than three months of each year in gaining experience in some form of woods work. The officials of the U. S. Forest Service and the lumber companies assist in placing the men for their first summer's work; their promotions through the succeeding vacations and positions after graduation are, therefore, entirely dependent on their own effort and ability.

It will be seen that this cooperative arrangement is most satisfactory; the student graduates as an experienced man and while gaining his experience, he has also earned money to pay in part for his college course.

Field Courses

To a great extent the work of the School of Forestry is carried on in the field and forest. Classes in Silviculture and Forest Management utilize the various forest types of the neighboring national forests. Classes in log scaling work on the log decks and rollways at the local sawmills. Classes in timber cruising are held entirely within the forest. Classes in grazing uses of the forest and in range management study the local forest ranges and make frequent visits to the herds and flocks of nearby ranches. Instruction is given in cooperation with specialists from the agricultural college. Use is made of nearby logging and lumber manufacturing operations by classes in lumbering and logging engineering. Experts and specialists in various lines of forestry are called upon freely for cooperation in the training given.

During a part of the spring quarter the school is moved to the shores of Flathead Lake in the Flathead National Forest where valuable use is made of forest and range types not found nearer the school. Various lumbering and wood using operations of that region are studied at this time.

Special Lecturers

The faculty of the School of Forestry is ably assisted by a staff of thirteen special lecturers who are experts and specialists in various lines of forestry and forest utilization. An unusual opportunity for this is afforded through the exceptional location of the Forest School. An especially valuable cooperation is offered by the officers of the Government Forest Service and men prominent in the stock raising and lumbering industries. The Agricultural College at Bozeman is organized as a part of the University of Montana and in the winter quarter of each year experts from that school and from the Government Agricultural Experiment Station are detailed to the School of Forestry as special lecturers in the courses in grazing and range management.

Requirements for Admission

The completion of a four years' preparatory or high school course is the standard for regular entrance to the School of Forestry, as in the other regular cousres of the University.

Students in high school and preparatory schools who plan to enter the School of Forestry should preferably include various elementary natural sciences, English, and Mathematics in their training. Students intending to specialize in Forest Engineering should also, when possible, include Manual Arts and Drawing in their preparation.

Special Students

Students over 21 years of age, who are not high school graduates and who are not candidates for degrees, may be admitted without the usual entrance credits, as special students, if they are prepared to pursue successfully the special courses desired, subject to the general rules of the University.

Special students may acquire status as regular students and become candidates for degrees by complying with the rules applicable to such cases.

Short Course

For admission requirements to the Short Course, see page 14.

Requirements for Graduation

Candidates for a degree of Bachelor of Science in Forestry must complete 186 credits of work in addition to the regular requirements of the University in Physical Education and Military Drill, and in addition, two summers of regularly approved Field Work. In case a student fails to offer this Field Work he may substitute for it credits earned in residence in the ratio of three credits for each summer of Field Work.

One credit represents three hours of time each week throughout one quarter, occupied in recitations or lectures, and in preparation outside of the class room. Time given to laboratory or field work is credited on the same basis of valuation—"three hours for one."

The courses leading to the degree of Bachelor of Science in Forestry will require twelve quarters of attendance and extend normally over four years, giving the student three months for summer work each year. Students will be expected to round out their theoretical training by employment in the Forest Service or with lumbering and logging companies during the summer quarter.

The courses of training in the School of Forestry are arranged under two branches of forestry:

I. Technical Forestry.

II. Forest Engineering.

The first two years of work as shown in the Schedule of Courses include fundamental courses in Mathematics, English, natural sciences, and elementary studies in subjects of general forestry.

The School of Forestry does not give Senior Examinations, except to candidates for Honors.

CURRICULUM IN FORESTRY AND FOREST ENGINEERING

Undergraduate Courses

Forestry and Forest Engineering

FIRST YEAR

General Botany	5	General Botany	5	General Botany	5
Mathematics	5	Mathematics or English	5	Mathematics or English	5
General Forestry	2	General Forestry	3	Fire Protection	4
Surveying and Mapping	3	Surveying and Mapping	3	Surveying and Mapping	3
Military Drill	1	Military Drill	1	Military Drill	1
Physical Education	1	Physical Education	1	Physical Education	1
	17		18		19

SECOND YEAR

English or an Elective	3	Forest Zoology	5	Forest Geology	5
Plant Histology	5	Plant Physiology	5	Ecology	5
Topographic Surveying	2	Logging	4	Topographic Surveying	2
Topographic Mapping	2	Military Drill	1	Topographic Mapping	2
Military Drill	1	Physical Education	1	Military Drill	1
Physical Education	1	Electives	3	Physical Education	1
Elective	4–5			Silvics	4
	17–18		19		20

Forestry

THIRD YEAR

Silviculture	4	Silviculture	4	Silviculture	4
Dendrology	4	Dendrology	4	Forest Pathology	5
Identification of Woods	4	Wood Technology	4	Forest Products	4
Forest Mensuration	3	Forest Mensuration	3	Forest Mensuration	3
Elective	4	Elective	4	Scaling and Cruising	3
	19		19		19

FOURTH YEAR

Management	4	Management	4	Management	4
Forest Policy	4	Forest Policy	4	Administration	4
Logging Engineering or Grazing Management	4	Logging Engineering or Grazing Management	4	Lumbering or Grazing Management	4
Electives	4–6	Electives	4–6	Electives	4–6
	16–18		16–18		16–18

Forest Engineering

THIRD YEAR

Identification of Woods	4	Wood Technology	4	Forest Products	4
Forest Improvements	4	Strength of Materials	4	Lumbering	4
Silviculture	4	Silviculture	4	Silviculture	4
Forest Mensuration	3	Forest Mensuration	3	Forest Mensuration	3
Electives	4	Electives	4	Scaling and Cruising	3
	19		19		18

Requirements for Admission

The completion of a four years' preparatory or high school course is the standard for regular entrance to the School of Forestry, as in the other regular cousres of the University.

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CURRICULUM IN FORESTRY AND FOREST ENGINEERING

Undergraduate Courses

Forestry and Forest Engineering

FIRST YEAR

General Botany	5	General Botany	5	General Botany	5
Mathematics	5	Mathematics or English	5	Mathematics or English	5
General Forestry	2	General Forestry	3	Fire Protection	4
Surveying and Mapping	3	Surveying and Mapping	3	Surveying and Mapping	3
Military Drill	1	Military Drill	1	Military Drill	1
Physical Education	1	Physical Education	1	Physical Education	1
	17		18		19

SECOND YEAR

English or an Elective	3	Forest Zoology	5	Forest Geology	5
Plant Histology	5	Plant Physiology	5	Ecology	5
Topographic Surveying	2	Logging	4	Topographic Surveying	2
Topographic Mapping	2	Military Drill	1	Topographic Mapping	2
Military Drill	1	Physical Education	1	Military Drill	1
Physical Education	1	Electives	3	Physical Education	1
Elective	4–5			Silvics	4
	17–18		19		20

Forestry

THIRD YEAR

Silviculture	4	Silviculture	4	Silviculture	4
Dendrology	4	Dendrology	4	Forest Pathology	5
Identification of Woods	4	Wood Technology	4	Forest Products	4
Forest Mensuration	3	Forest Mensuration	3	Forest Mensuration	3
Elective	4	Elective	4	Scaling and Cruising	3
	19		19		19

FOURTH YEAR

Management	4	Management	4	Management	4
Forest Policy	4	Forest Policy	4	Administration	4
Logging Engineering or Grazing Management	4	Logging Engineering or Grazing Management	4	Lumbering or Grazing Management	4
Electives	4–6	Electives	4–6	Electives	4–6
	16–18		16–18		16–18

Forest Engineering

THIRD YEAR

Identification of Woods	4	Wood Technology	4	Forest Products	4
Forest Improvements	4	Strength of Materials	4	Lumbering	4
Silviculture	4	Silviculture	4	Silviculture	4
Forest Mensuration	3	Forest Mensuration	3	Forest Mensuration	3
Electives	4	Electives	4	Scaling and Cruising	3
	19		19		18

FOURTH YEAR

Forest Management	4	Forest Management	4	Forest Management	4
Logging Engineering	4	Logging Engineering	4	Logging Railroads	4
Electives	7-9	Electives	7-9	Electives	7-9
	15-17		15-17		15-17

Electives in Forestry

Slide Rule	1	Grazing Management	4	Economics of Forestry	3
Forest Mapping	2	Slide Rule	1	Slide Rule	1
Grazing Management	4			Grazing Management	4

Electives in Other Schools and Departments

In addition to the above courses, students after the freshman year may elect not to exceed 12 credits each year in any school or department of the University, subject to the approval of the faculty of the School of Forestry and of the department in which the work is taken.

The English requirements are those of the general University.

DESCRIPTION OF COURSES

I. Forest Policy and Administration

11a. General Forestry. 1 Q. Autumn. 2 cr. Required of all freshmen. The course covers the functions and characteristics of forests, their benefits and use. The forests of the world, their distribution and importance. Forest regions of the United States. Mr. Skeels.

11b. General Forestry. 1 Q. Winter. Freshman. 3 cr. Prerequisite, Forestry 11a. Forestry as a science. The art of forestry. Forestry as a profession. Definition of terms used in forestry. Mr. Skeels.

12. Economics of Forestry. 1 Q. 3 cr. Junior or Senior. A study of forest problems from an economic standpoint, the relation of the state to the forest resources, forest requirements of the nation, economic results of forestry practice. Text: Fernow's Economics, Public Documents. Mr. Skeels and Mr. Spaulding.

13a. Forestry Policy. 1 Q. Autumn. 4 cr. Junior or Senior. Prerequisite, Silvics 22. The forester and forest owner and the public. A study of the fundamental principles underlying the forest policies of the various nations and the United States. The theories of forest taxation. The forest laws of the states. Public land law in its relation to the forester. Public relations. Texts and collateral reading: Fernow, Economics of Forestry; Kinney, Development of Forest Law in America; Kinney, Essentials of American Timber Law; Schlick, Forest Policy; Ise, Forestry Policy in America. Mr. Spaulding.

13b. Forest Policy. 1 Q. Winter. 4 cr. Prerequisite, 13a. A continuation of the previous course. Mr. Stone and Mr. Spaulding.

13c. Forest Administration. 1 Q. Spring. 4 cr. Prerequisite, 13b. Public and private forest organization, the handling of forest problems, general organization, the personnel question, overhead and supervision, efficiency methods, detailed analysis of the various regulations and instructions, and their practical application from the forest officers' and forest users' standpoint. Mr. Clark.

21. Fire Protection. 1 Q. Spring. 4 cr. Freshman. A detailed analysis of fire organization, prevention, detection, and suppression, including the adjunct insurance bases, surveys, risks, liabilities and suppressive factors. Types and use of instruments. Cooperation. Texts: Fire fighting manuals, Western Forestry and Conservation Association, and Government publications. Mr. Spaulding.

II. Silviculture and Forest Management

22. Silvics. 1 Q. Spring. 4 cr. Sophomore or Junior. Prerequisite, Botany 22. A study of the behavior and habits of growth of our most important trees in forest stands. Requirements for growth. Resistances and susceptibilities. Influences on site, region and other environmental conditions—form and habit, normal stands and yields, seeding qualities and reproduction, adaptability to silvicultural treatment and management. Mr. Skeels.

23a. Silviculture. 1 Q. Autumn. 4 cr. Prerequisite, Botany 151, Silvics 22. Juniors only. Forest distribution by regions, types and species. A study of forest types and their relation to locality, site, quality and environmental conditions, habits of development and growth, origin, transition types and temporary types, climax types. Natural reproduction, protection and treatment, stands and yields. Mr. Skeels.

23b. Silviculture. 1 Q. Winter. 4 cr. Prerequisite, 23a. Systems of silvicultural treatment. Regeneration methods. Intermediate cuttings. Conservative exploitations of woodlands, forest protection. References: Hawley. Practice of Forestry; Graves, Principles of Handling Woodlands. Mr. Skeels.

23c. Silviculture. 1 Q. Spring. 4 cr. Prerequisite, 23b. Afforestation and reforestation. Natural and artificial reproduction, forest seed; properties, characteristics, collection, storage, testing, etc. Direct seeding, nursery practice, methods of field planting. Reference: Toumey, Seeding and Planting in the Practice of Forestry. Mr. Skeels.

26a. Forest Management. 1 Q. Autumn. 4 cr. Prerequisite, Forest Mensuration 29c and Silviculture 23c. This course covers forest valuation, definition of values, nature of forest capital, interest rates on forest capital, formulae of interest calculation, methods of determining values, statistics, financial effects of management as related to forest valuation, methods of measuring profits of forestry. References: Roth, Forest Valuation; Recknagel and Bentley, Forest Management; Schlick, Forest Management, Vol. III. Mr. Skeels.

26b. Forest Management. 1 Q. Winter. 4 cr. Prerequisite, 26a. This course deals with forest regulation and the foundations of working plans and covers, forest per cent and the several forest increments; rotations, financial, physical, technical, economical and natural or silvicultural; relations of the attributes of the normal forest, normal increment, normal growing stock and normal distribution of age classes; determination and regulation of the yield. References: Same as in 26a and Roth, Forest Regulation. Mr. Skeels.

26c. Forest Management. 1 Q. Spring. 4 cr. Prerequisite, 26b. Preparation of Forest Working Plans; continuing determination and regulation of the yield, collection and arrangement of forest statistics, division and allotment of the forest area for treatment, administration and management, preparation of the working plan report. About one half of the class time will be in the field and preparation of working plans will deal with actual field problems. Mr. Skeels.

29. Forest Mensuration. 3 Q. Autumn, winter, spring. Continuous. 9 cr. Junior. Prerequisites, Mathematics 10 and Topographic Surveying 43ab. The construction and theory of log rules. Principles underlying the construction of volume and taper tables. Influence of form of stems on volume. Principles and methods of determining the cubic contents of trees and stands of timber, estimation of standing timber, the study of growth of trees and stands. Factors affecting the growth of stands. Yield tables, their value to the forester. Determination of growth per cent. Text: Chapman, Forest Mensuration. References: Graves, Forest Mensuration; Schlick, Manual of Forestry, Vol. III. Field Work to be done at the School Forest in Pattee Canyon with trips of one or more days duration to logging camps. Mr. Clark.

III. Forest Utilization

31. Wood Technology. 1 Q. Winter. 4 cr. Prerequisite, Botany 23. A microscopic study of the characteristics and methods of identification of the economic woods of the United States; their strengths with methods of determination; their durability with methods of preservative treatment and survey of the preservatives used. Texts: Record, Mechanical Properties of Wood; Betts, Timber. Its Strength, Seasoning and Grading; Weiss, Preservation of Structural Timber. Mr. Ramskill.

32. Forest Products. 1 Q. Spring. 4 cr. Prerequisite, Wood Technology 31. A survey of the character, extent and value of the products from the forests of the world ,with special reference to those of the United States. Text: Brown, Forest Products. References: Kellogg, Lumber and Its Uses; Watt, The Commercial Products of India; Howard, Timbers of the World; Zon and Sparhawk, Forest Resources of the World. Mr. Ramskill.

33. Logging. 1 Q. Winter. 4 cr. Sophomore. Prerequisite, Surveying 41c and 43a. A study of the forest regions of the United States from the lumbering standpoint, and the logging methods in use in each, with special reference to the Inland Empire. Visits to nearby logging operations when practical. Reference: Bryant, logging. Mr. Ramskill.

34. Lumbering. 1 Q. Spring. 4 cr. Prerequisites, Mensuration 29b and Logging 33. A study of the lumbering industry of the United States with special reference to the western states. Types of sawmills and equipment in use and including costs of production, prices and markets. Visits to nearby sawmills. References: Bryant, Lumber; Oakleaf, Lumber Manufacturers; Kellogg, Lumber and Its Uses. Mr. Ramskill.

35. Scaling and Cruising. 1 Q. Spring. 3 cr. Prerequisite, Forest Mensuration 29b. A study of log scaling and timber cruising. Commercial measurements of logs and other forest products. Commercial measurement of standing timber by the various methods used by foresters and practical timber cruisers. Scaling to be done at the nearby sawmills. Cruising in the school forest in Pattee Canyon and elsewhere. Mr. Clark.

36c. Logging Railroads. 1 Q. Spring. 4 cr. Senior. Prerequisite, requisites, Forest Mensuration 29c; Topographic Surveying and Mapping 43 and 44; Logging 33. The application of engineering principles to logging operations. A study of the factors governing the cost of felling, bucking, swamping, skidding and log transportation. Visits to nearby logging operations when practical. Mr. Ramskill.

36b. Logging Engineering. 1 Q. Winter. 4 cr. Senior. A continuation of 36a, in which the data entering into, and the methods employed in the preparation of, logging plans are studied, and a sample plan of a nearby area prepared. Mr. Ramskill.

36c. Logging Railroads. 1 Q. Spring. 4 cr. Senior. Prerequisite, Logging Engineering 36b. Reconnaissance; preliminary surveys and location; the laying out of logging railroads by practical methods; by Abney level and tape; by transit, level and tape; topography and cross-sectioning; slope stakes; trestles and culverts; cost estimates; railroad drafting. Reference: Searles and Ives, Field Engineering; Raymond, Railroad Engineering; Carhart, Field Book for Civil Engineers. Mr. Ramskill and Mr. Borel.

est rates on forest capital, formulae of interest calculation, methods of determining values, statistics, financial effects of management as related to forest valuation, methods of measuring profits of forestry. References: Roth, Forest Valuation; Recknagel and Bentley, Forest Management; Schlick, Forest Management, Vol. III. Mr. Skeels.

26b. Forest Management. 1 Q. Winter. 4 cr. Prerequisite, 26a. This course deals with forest regulation and the foundations of working plans and covers, forest per cent and the several forest increments; rotations, financial, physical, technical, economical and natural or silvicultural; relations of the attributes of the normal forest, normal increment, normal growing stock and normal distribution of age classes; determination and regulation of the yield. References: Same as in 26a and Roth, Forest Regulation. Mr. Skeels.

26c. Forest Management. 1 Q. Spring. 4 cr. Prerequisite, 26b. Preparation of Forest Working Plans; continuing determination and regulation of the yield, collection and arrangement of forest statistics, division and allotment of the forest area for treatment, administration and management, preparation of the working plan report. About one half of the class time will be in the field and preparation of working plans will deal with actual field problems. Mr. Skeels.

29. Forest Mensuration. 3 Q. Autumn, winter, spring. Continuous. 9 cr. Junior. Prerequisites, Mathematics 10 and Topographic Surveying 43ab. The construction and theory of log rules. Principles underlying the construction of volume and taper tables. Influence of form of stems on volume. Principles and methods of determining the cubic contents of trees and stands of timber, estimation of standing timber, the study of growth of trees and stands. Factors affecting the growth of stands. Yield tables, their value to the forester. Determination of growth per cent. Text: Chapman, Forest Mensuration. References: Graves, Forest Mensuration; Schlick, Manual of Forestry, Vol. III. Field Work to be done at the School Forest in Pattee Canyon with trips of one or more days duration to logging camps. Mr. Clark.

III. Forest Utilization

31. Wood Technology. 1 Q. Winter. 4 cr. Prerequisite, Botany 23. A microscopic study of the characteristics and methods of identification of the economic woods of the United States; their strengths with methods of determination; their durability with methods of preservative treatment and survey of the preservatives used. Texts: Record, Mechanical Properties of Wood; Betts, Timber. Its Strength, Seasoning and Grading; Weiss, Preservation of Structural Timber. Mr. Ramskill.

32. Forest Products. 1 Q. Spring. 4 cr. Prerequisite, Wood Technology 31. A survey of the character, extent and value of the products from the forests of the world ,with special reference to those of the United States. Text: Brown, Forest Products. References: Kellogg, Lumber and Its Uses; Watt, The Commercial Products of India; Howard, Timbers of the World; Zon and Sparhawk, Forest Resources of the World. Mr. Ramskill.

33. Logging. 1 Q. Winter. 4 cr. Sophomore. Prerequisite, Surveying 41c and 43a. A study of the forest regions of the United States from the lumbering standpoint, and the logging methods in use in each, with special reference to the Inland Empire. Visits to nearby logging operations when practical. Reference: Bryant, logging. Mr. Ramskill.

34. Lumbering. 1 Q. Spring. 4 cr. Prerequisites, Mensuration 29b and Logging 33. A study of the lumbering industry of the United States with special reference to the western states. Types of sawmills and equipment in use and including costs of production, prices and markets. Visits to nearby sawmills. References: Bryant, Lumber; Oakleaf, Lumber Manufacturers; Kellogg, Lumber and Its Uses. Mr. Ramskill.

35. Scaling and Cruising. 1 Q. Spring. 3 cr. Prerequisite, Forest Mensuration 29b. A study of log scaling and timber cruising. Commercial measurements of logs and other forest products. Commercial measurement of standing timber by the various methods used by foresters and practical timber cruisers. Scaling to be done at the nearby sawmills. Cruising in the school forest in Pattee Canyon and elsewhere. Mr. Clark.

36c. Logging Railroads. 1 Q. Spring. 4 cr. Senior. Prerequisite, requisites, Forest Mensuration 29c; Topographic Surveying and Mapping 43 and 44; Logging 33. The application of engineering principles to logging operations. A study of the factors governing the cost of felling, bucking, swamping, skidding and log transportation. Visits to nearby logging operations when practical. Mr. Ramskill.

36b. Logging Engineering. 1 Q. Winter. 4 cr. Senior. A continuation of 36a, in which the data entering into, and the methods employed in the preparation of, logging plans are studied, and a sample plan of a nearby area prepared. Mr. Ramskill.

36c. Logging Railroads. 1 Q. Spring. 4 cr. Senior. Prerequisite, Logging Engineering 36b. Reconnaissance; preliminary surveys and location; the laying out of logging railroads by practical methods; by Abney level and tape; by transit, level and tape; topography and cross-sectioning; slope stakes; trestles and culverts; cost estimates; railroad drafting. Reference: Searles and Ives, Field Engineering; Raymond, Railroad Engineering; Carhart, Field Book for Civil Engineers. Mr. Ramskill and Mr. Borel.

IV. Range Management

39a. Grazing Management. 1 Q. Autumn. 4 cr. Junior or Senior. Prerequisite, Plant Ecology 151, Plant Histology 21, Plant Physiology 22, Surveying 41abc, Mapping 42abc. The course covers a study of the types and breeds of livestock ranged on the National Forests; the theory and practice of breeding; feeds and feeding. The common diseases and methods of treatment. Mr. Spaulding.

39b. Grazing Management. 1 Q. Winter. 4 cr. Junior or Senior. Continuation of course 39a. The work covers the choice of type and breed of animals, choice of method of handling livestock on the range. Plans for improvements, breeding practice, handling stock on the range, and administration. Mr. Spaulding.

39c. Grazing Management. 1 Q. Spring. 4 cr. Junior or Senior. Continuation of course 39b. This course covers the methods of investigating range conditions, surveying, mapping, collection and tabulation of data relative to forage, water, and carrying capacity conditions, range improvements, range reconnaissance, methods of handling stock in use, etc., necessary for the preparation of working plans, and the preparation of a report covering the actual range conditions. Texts: Feeds and Feeding, Henry and Morrison; Types and Breeds of Farm Animals, Plumb; Market Types and Classes of Livestock, Vaughn; Principles of Breeding, Davenport; various Government publications and documents. Mr. Spaulding.

V. Forest Engineering

41a. Surveying. 1 Q. Autumn. 2 cr. Freshman. Traverse board surveys; use and care of the surveyor's compass; computation of closure and area by latitude and departure and double meridian distance. One hour lecture and six hours field practice per week. Text: Tracey, Plane Surveying. Mr. Borel.

41b. Surveying. 1 Q. Winter. 2 cr. Prerequisite, 41a. Freshman. Differential and profile leveling; care and adjustment of the Wye and Dumpy level. Instruction covers U. S. land survey methods; retracements; subdivision of sections. One hour lecture and five hours field practice. Mr. Borel and Mr. Ramskill.

41c. Surveying. 1 Q. Spring. 2 cr. Prerequisite, 41a. Freshman. Transit and tape surveys. Running of control for topographic work. Triangulation; surveys of ranger stations and homesteads. One hour lecture and five hours field practice. Mr. Borel.

42a. Mapping. 1 Q. Autumn. 1 cr. Freshman. Elementary map making and lettering; conventional signs for maps used in forest work. Map construction and use. Four hours practice in drawing room per week. Mr. Borel, Mr. Ramskill.

42b. Mapping. 1 Q. Winter. 1 cr. Prerequisite, 42a. Freshman. Practice in plotting and compiling maps from field notes of logging unit and homestead surveys. Plotting profiles and establishing grade. Four hours practice in drawing room per week. Mr. Borel, Mr. Ramskill.

42c. Mapping. 1 Q. Spring. 1 cr. Prerequisite, 42b. Freshman. Compiling of maps from individual notes taken in the field by the surveying class. Determination of area by planimeter; use of lettering scale for map titles; map reproduction methods, blue printing, white printing and photostating. Four hours practice in drawing room per week. Mr. Borel, Mr. Ramskill.

43abc. Topographic Surveying. 2 Q. Autumn, spring. 2 cr. each quarter. Sophomore. Prerequisite, Surveying 41abc, Mapping 42abc, and Plane Trigonometry 13. The transit and stadia method; trigonometric leveling; the plane table with telescopic allidade. A field collection of data for preparation of maps to be used in the planning of logging operations; making field maps for grazing reconnaissance. Abney level method of mapping with special application to the surveying of timbered regions. Observations for the meridian, solar and stellar. Five hours field practice per week supplemented by lectures and recitations. Text: Tracey, Plane Surveying. Reference: Wilson, Topographic Surveying. Mr. Borel.

44ab. Topographic Mapping. 2 Q. Autumn, spring. 2 cr. each quarter. Sophomore. Prerequisite, Mapping 42abc and 43ab taken simultaneously. Practice in the production of finished topographic maps from field work by the topographic surveying class; make up of base maps and compilation of data; study of data to be included in fire control maps; grazing; type and stand maps; timber survey maps. Mr. Borel.

46. Forest Improvements. 1 Q. Autumn. 4 cr. Sophomore. Prerequisite, Mapping 42. Study of problems in trail location and construction; arrangement of buildings and sanitation of station sites and logging camps. Principles of construction of dwellings and other buildings. Construction and maintenance of metallic and grounded telephone lines. Design, repair and installation of local battery telephone sets. Mr. Clark.

48. Strength of Materials. 1 Q. Winter. 4 cr. Sophomore or Junior. Prerequisite, Algebra 12, Plane Trigonometry 13. A course dealing with the properties of materials used in engineering construction; a study of iron, steel and timber under compression, tension, and shear; the theory of beams; deformations and elasticity; plain and reinforced concrete. Textbook: Merriam, Strength of Materials. Mr. Carey.

51. The Slide Rule. (Subject to demand for class.) 1 cr. For all students. Study and practice with the various makes of slide rules as an aid to rapid mathematical calculations. The Mannheim, Stadia, Polyphase, and Log rules, their theory and use. Reference: Cox, Complete Manual on the Slide Rule. Mr. Borel.

52. Forest Mapping. 1 Q. (Subject to demand for class). Autumn or winter. 2 cr. Junior. Prerequisite, enrollment in Topographic Mapping 44. Practice in making base maps; methods of building small scale maps of large areas. Map projection in detail with the following projections: Orthographic, Stereographic, Mercator, Rectangular; simple conic; Boones and Polyconic, explaining their respective uses in the make-up of forest maps. Mr. Borel.

SHORT COURSE

The Short Course, or Ranger School, is held each year between the first Wednesday in January and the last Saturday in March.

It is the purpose of this school to enable forest officers and other woods employees to keep abreast of their profession. Forest Administration and Lumbering are rapidly passing into the hands of highly technical organizations; consequently the need of special training is becoming daily more apparent to the wide awake man in order that he may maintain his position with satisfaction to himself and his superior officers and to gain the promotion he feels to be his due. Men desiring to enter this class of work find the Short Course an excellent foundation upon which to undertake the necessary examination.

The work of the Short Course is carried on with helpful cooperation from the United States Forest Service. Experts in various branches of forest service work are detailed under authorization of the Secretary of Agriculture as special lecturers in the school. Other state and government officials and experts in the employ of lumber companies assist in the training. Special work in grazing is given by the state and other veterinarians and members of the staff of the Montana State College.

Opportunity is given for first year specialization in General Forestry, Range Management, or Lumbering and Logging. Those who return for a second Short Course may be permitted to select a schedule of more advanced subjects in accordance with their own needs or to devote as much time to a particular phase as they may desire. Those who through previous education or practical experience show an ability to carry second term work may be permitted to do so without completing the full requirements of the basic course.

Owing to a rapidly increasing attendance, enrollment in the Short Course must now be limited to not more than forty men. Applications for registration in excess of that number will be rejected. Permission to register must be secured in advance.

The following subjects are offered each Short Course:

Course No.	Subject	Short Course Units	Hours per Week. Lectures and Recitations	Laboratory and Field
RS 1	Surveying and Mapping	3	2	4
RS 2	Topographic Surveying and Mapping	3	2	3
RS 3	Forest Improvements	3	2	3
RS 4	Forest Administration	2	2	....
RS 5	Fire Protection	3	3	1
RS 6	General Forestry	3	3	....
RS 7	General Botany of Range Plants	3	2	3
RS 8	Elements of Silviculture	3	3	....
RS 10	Lumbering	3	3	2
RS 11	Scaling and Cruising	3	2	3
RS 12	Logging Engineering	3	2	3
RS 13	Forest Appraisals	2	2	2
RS 14	English	3	3	....
RS 15	Range Management	3	2	3
RS 17	Breeds and Breeding	2	2	....
RS 18	Diseases of Livestock	2	2	....
RS 19	First Aid and Camp Sanitation	2	2	....
RS 20	Short Course Mathematics	3	3	....
RS 21	Short Course Trigonometry	3	3	....
RS 22	Elementary Forest Mensuration	3	3	....

Special courses to meet individual needs may be provided upon demand of five or more students.

Requirements for Admission

The following may be admitted as students in the Short Course:

Forest rangers, guards, and other employees of the Federal Forest Service, State Forest Organizations, or Timber Protective Associations.

Employees of logging and lumbering companies.

Any person of good character at least 21 years of age, who has had experience in forestry or woods and who can furnish evidence of his ability to pursue the subjects as outlined.

Students who have completed a high school course or equivalent preparatory training and who are otherwise qualified to benefit by Short Course training.

Further information relative to the entrance qualifications of individuals will be given upon application to the Dean, School of Forestry, State University of Montana, Missoula.

Expenses of the Ranger School

Expenses for Short Course students have been made as small as possible. Entrants owning drawing instruments should bring them. Forest officers who attend the school should correspond with the Dean of the School about certain books and forest equipment which may be brought from their forests.

The cost to the average Short Course student is about as follows:

Entrance fee	$ 5.00
Registration fee	5.00
Student Activity fee	5.00

General Deposit	20.00
Health Service fee	2.50
Books and Notebooks	10.00
Board and Room, 12 weeks	90.00—125.00
Forest Club dues and entertainments	5.00
Add for drawing instruments if purchased	12.50

For information about the non-resident fee, see page 34.

Forestry Building

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Health Service fee	2.50
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Board and Room, 12 weeks	90.00—125.00
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Undergraduate courses specializing in either forestry or forest engineering and leading to the degree of Bachelor of Science in Forestry.

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Exceptional opportunities for research or investigative work in Silviculture, Management or the Lumber Industry.

For information address

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In Memoriam

JAMES DEJARNETTE

HAROLD LANSING

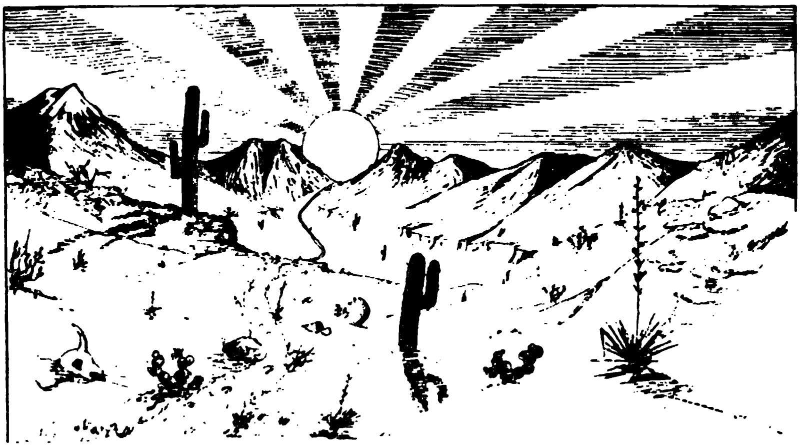
GEORGE ENGLAND

To those in the Profession of Forestry:

This, the 1924 issue of the Forestry Kaimin, is the first to be published under the new policy of the Club. The size of the magazine has been reduced with a view toward greater convenience in handling. We have endeavored to make the new Kaimin a worth-while magazine, and it is our hope that within these pages will be found items that are of help and interest to Foresters. If we have achieved this purpose we shall feel that the time devoted by Club members in the preparation of the Kaimin has been well spent.

We wish to thank those who submitted material to us for their sincere interest and hearty co-operation. Without their aid this issue would not have been possible.

—The Editors.



THE TRAIL TO THE SETTING SUN

By STEWART VAN DER VEER

**As I look back o'er the winding track that leads to the setting sun,
There's a poignant pang like a bowstring's twang when I think that my race is run
For the lone campfire in the swamp and mire, or high on the mountain's peak,
Has spread its dust, as a campfire must, when the distant spaces speak.**

**How I long for a night in the campfire's light—a pipe and a trusted friend,
With a darting blaze and the white smoke's haze, and no thought of the trail's true end
And I dream and sigh for the wild duck's cry, with the song of the wind in the breaks
Just to make.my way at the break of day to the plains and distant lakes.**

**There's a certain charm in a night alarm or the cry of a frightened loon
And the crunch, crunch, crunch, as the horses munch the grass 'neath the rising moon.
Yes, I want to get back from the beaten track to the smell of the trees again
Where a man's scot free and he laughs in glee at the book-wrought fetters of men.**

**Have you ever heard some restless bird away there in the dark,
While a wild-cat creeps, then swiftly leaps and leaves his crimson mark,
While down by the lake in the matted brake, a bullfrog croaks in the grass,
As with sulking fear, near a rotting steer, the coyotes chant their mass?**

**When the morning light drove off the night and the embers, cold and grey,
Made a ghostly mound on the dampened ground at the break of the new-born day,
With the fire just right and the pipes alight we laughed as the tea-pot sang
And the horses pranced while the trail-hounds danced round the heels of my bay mustang.**

**Now I chain my mind to the daily grind and I think, with a rueful smirk,
Of the days gone by and the boundless sky and this hellish thing called work,**
***While my fingers itch* for the diamond hitch and the cool, white butt of a gun;**
***Fate shuffled the pack* but I think I'll go back to the trail of the setting sun.**

A DAY WITH RANGER BILL

By W. M. RUSH

Deputy Supervisor, Lewis and Clark National Forest.

It was during those times along about 1910 that Gregory Fitzhugh, the famous author of out-door stories, made a trip on the Potomac National Forest to secure local color for that new book he was writing on "The Psychological Effects of the Grandeur and Nobleness of Lofty Mountain Peaks on the Forest Ranger's Mind." His previous book, entitled "The Life-Story of Percy Reginald Morris-Ross, the Forest Ranger of Pleasant Dell Valley," had proven very popular and many copies had been sold in the Atlantic states, a few scattered copies even making their way as far west as the Marietta River.

Picture, if you can, our friend Gregory, about fifty years of age, grey haired, with considerably more embonipoint than most out-door men carry, dressed in approved Abercrombie & Fitch fashion, and with the burden on his shoulders of giving to the world the story of the romantic life of the riders of our great National Forests.

Gregory received a large white horse, equipped with a McClellan saddle and martingale, and took his place at the head of the party, which was composed of the District Forester, Maulson, a plant expert of the Bureau of Plant Industry, Hauton, the supervisor of the Potomac, and Harry Coffman, the district ranger. In the order named they rode up the historic valley of the Pebble River to old Daddy Mole's hotel. At this place they were to meet Ranger Bill, who would relieve Ranger Harry as wet-nurse to the party.

Ranger Bill was unaware of the honor which was to be his of acting the role of the typical forest ranger in the ensuing seven days and was not at all prepared to do the part. The previous two days he had spent in helping segregate three bands of sheep which had run together the week before when a careless camper let his campfire get away and burn up a few sections of timber and, incidentally, furnished Bill and fifty men with plenty of work. So you can imagine how Bill looked. Unbathed and unshaven for about two weeks, hair that had been untrimmed for a couple of months, clothes—well, hardly enough remnants of clothes to mention, dirty on the outside and oh, so dry on the inside, riding out to Daddy Mole's to clean up and take on a little of Daddy's famous rhubarb wine before hitting the sticks again. Just imagine his chagrin when his old cayuse ambled into the corrals and heard Coffman tell him that he was elected for a week's trip with the highbrows. Old Gregory would not shake hands with what he thought was a sheepherder, as Bill actually looked to be, and the District Forester and Hauton hated to before Gregory, as all day long they had been away up in the clouds with their conversation and it was hard for them to come down to earth so quickly.

That night, after supper, Bill listened to Gregory's stories about Southern Italy, the picturesque shepherds in the Swiss Alps, the wonderful Mount Blanc and the Dent la Chat in France, the flowery fields in the forests of Germany, and the wonderful herds of red deer in the

Black Forest. Bill wished that Gregory were in some of those places instead of being on the Potomac National Forest in Montana, as on the morrow he must pilot the author and his party along fifteen miles of sheep driveway over which thirty thousand head of Merinos had passed only a few weeks previous, and then, for three miles, within sight of the still smouldering three thousand acre fire which was now under patrol.

Bill avoided the author the next morning and rode in the lead up the trail which was also the sheep drive-way, with Mr. Maulson, the poison plant expert. Maulson was a good fellow to be out with, but, as with most specialists, was wrapped up in his work and thought of little else besides poison plants. After the party had been out for a half hour or so, the conversation between Bill and Maulson drifted, much against Bill's wishes, to stock-poisoning plants.

"I noticed considerable patches of Prunus demissa bush along the rim yesterday. Are many sheep poisoned by it in the fall?" asked Maulson.

"Nope," said Bill.

"I presume you do not have Hymenoxys floribunda in this locality?"

"Don't think so," ventured Bill.

"We carried on studies in Colorado last year on the effects of Astragallus mollisimus and Hymenoxys floribunda as regards sheep and secured some very interesting results."

"Is that so?" murmured tthe now thoroughly subdued Bill, looking for a chance to escape.

"Yes, and also got some valuable data on Aconitum columbianum."

But Bill had made his slip by stopping to cinch up his saddle and letting the District Forester ride past him. This left Bill between the D. F. and Hauton, the supervisor.

Up to this time Hauton had not had a chance at the ranger at all and so started in to make the most of this opportunity.

"How many chains of fire-line did you build on that fire?"

" 'Bout two and a half miles," promptly replied Bill.

"What is the cost per chain of held line?"

"Can't say yet. Haven't had time to figger it up," said Bill.

"Have you figured up the expectation value of the young growth destroyed, and the replacement cost apportioned throughout a ten-year period?"

"Well, I started to do that but haven't got it done yet."

Bill was again getting into hot water but the author was behind him and the D. F. ahead, so he thought he would stick it out for a while. But the D. F. had all he wanted of poison plant dope and, with the experience born of long practice, deftly cut in between Bill and the supervisor by stopping and having Bill look at a loose shoe on his horse. Our ranger was used to all sorts of hardships, so he only sighed deeply when the District Forester propounded his first observation.

"This five-needle pine here is the Pinus flexilis, is it not?"

"Yes," replied Bill.

"How do you distinguish it from the Pinus albicaulis?"

That was a stumper and Bill saw where he had been trapped, but he, too, used his noodle once in a while and, quickly dismounting and looking intently at some dog tracks in the soft earth along the trail, remarked: "Here are some wolf tracks. A male wolf, about a three-year old. Has been in a trap some time or other. Passed along here about two hours ago."

Not a question was asked—no one wanted to appear as not being perfectly aware of the accuracy of Bill's deductions. The ranger had maneuvered himself to the rear of the party with the author between himself and the D. F.

By this time the party was on top of the divide and the country for many miles around was in view. The author was ecstatic over the scenery.

"Why, the Matterhorn is no more beautiful, no more grand, no more awe-inspiring than this," he exclaimed. "This would be a regular Field of Ardath if it wasn't for the despicable sheep you Forest Service men allow in here. The nation's wonderful resources should not be exploited and spoiled by a few mercenary stockmen and I am going to see that proper legislation is introduced in our Congress to prevent it. I shall call on Mr. Roosevelt personally, when I return to Washington, and take this matter up with him. Why, just look! Erosion is already taking place on this very spot, and it will be only a matter of time until deep gullies are washed out and the mountains ruined."

As I have stated, Bill was inured to hardships of all kinds but this last was more than any mortal could stand, so he rode up to the supervisor and asked him to go on into camp with the party and he would climb up to the lookout point to see how the lookout was making it, and would be in camp before dark. He rode off hurriedly before anyone could offer to go with him.

Bill rode up on the hill, dismounted, and watched the outfit winding down the trail.

"I wish that another three thousand acre fire would start," he growled. "How in heck I will manage to stick it out seven days with that gang the Lord only knows. Guess I'd better go down, though, and see that they shut the pasture gate as I do not want to hunt horses in this country."

After shutting the gate behind them he made a small detour of the camp and came to Frenchy's tent. Frenchy was not a shepherd, even if he did herd sheep, in fact, he would have been highly insulted had anyone called him a shepherd. The only name he was ever called by was "Frog sheepherder," except that at times various and sundry adjectives were added to this title.

Frenchy was fresh from the old country and knew but little about Montana's flora, fauna, customs or people. That day a small black bear had come into his tent and was surprised by Frenchy who, thinking the bear was someone's big dog, proceeded to kick it out of the tent. It must have been an awful battle as Frenchy's clothes were torn to ribbons and stained with blood.

"He bite me He broke my shirt, he broke my pants, he bite me, he claw me!‘ Sacre, he bad dog, le chien noir!" excitedly explained the sheepherder to Bill.

"Well, I'll be darned, Frenchy, if you haven't licked a bear single-handed!"

"Oui, oui," responded Frenchy. "Mais, he broke my bran' new shirt!"

The ranger had a good laugh over the incident and after eating supper with the sheepherder, went on to the Forest Service camp where, as he expected, the author was having a hard time finding a suitable spot on which to lay his camel's hair blankets. Although he had written numerous stories of camping trips, this was the first trip he had made where the first camp was two days' travel on horseback, and old Gregory was sore, both in body and mind. His legs and thighs ached and his underwear stuck to the sore places, the grub did not suit him at supper time, the smell of sheep along the trail had offended his fastidious taste and the sight of the three thousand acres recently burned was a blow to his ideas of forest protection.

When he saw Bill he called him to one side and asked, "Would you be offended if I returned to Mr. Mole's hotel tomorrow and awaited the return of this party at that place? I find that I cannot do my work so well nor so effectively while camping out this way as I could in more harmonious surroundings."

"We would most surely miss you on the trip but if you find that your work can be done as well at Mole's as with us, I think perhaps it can be arranged so that you can go out tomorrow."

To himself Bill thought, "Gosh! I imagined he'd last longer than that, but I'm sure relieved some. If only the lookout will report another fire in the morning I'll be happy."

All of which explains why "The Psychological Effects, etc.," by Gregory Fitzhugh has never been written. Local color was too hard to obtain.

RAIN ON A TENT

It's raining, raining, raining
As I lie here on my bed,
A drizzle, drip and drizzle
On the canvas overhead.
So I draw the blankets closer
And think of the ancient jest:
"It rains all night—and Sundays,
So the foresters can rest."

JACK FROHLICHER.

—By Permission of U. S. F. S.

A STATE FOREST SCENE

The potentiality of our State Forest resources may be felt as well as seen in our deep forests and rapid streams.

MONTANA'S STATE FORESTS

By R. P. McLAUGHLIN,
State Forester.

Montana owns about 500,000 acres of State Forests. These were acquired when the state was created, through grants made by the federal government, chiefly to the common schools and other educational institutions of the state. Montana has been, therefore, a forest owner from the time it was made a state.

The state constitution classifies all lands which are chiefly valuable for the timber that is on them, as timber lands (forests). The constitution, under the requirements of the enabling act, fixed a minimum land value of $10 per acre for all state lands, and requires that each tract proposed for sale must be appraised, and sale cannot be made for less than the appraised price. Under these requirements, therefore, speculation in the purchase of forest lands is practically prohibitive, since a law was also passed in 1909, fixing the minimum price per thousand feet of state timber at $3. Hence the appraisal of a tract of state land will obtain about these minimum figures: $10+(3x7)=$10+$21, or $31 per acre, when $10 per acre is the minimum land value fixed by the constitution and 7,000 feet equals a fair stand of timber per acre, valued at $3 per 1,000 feet, the minimum value of green saw timber as fixed by law. Since no one can afford to purchase forest lands at these figures, the situation is fortunate for the state, and the wisdom of these provisions is becoming every day more apparent.

The State Permanently in Forestry.

Therefore, Montana is permanently an owner of forest lands. It can not get out of the business. Possibly this fact was recognized when in 1909, by legislative enactment, the foundations for their more scientific management were established by creating the outlines of a State Forest Department. Since the state can not get out of the business of a forest owner, and since the business is a profitable one, it is logical for the state not only to stay in the forestry business, but to expand and extend its forest ownership. Moreover, the state must stay in the game, and grow into the game, by reason of those conditions that make it impossible to escape the responsibility of preserving its own resources. To supply our industries we are cutting timber from all forest lands in the state, at the rate of nearly 80,000 acres per year. Variously owned forest lands are being burned at a fully equal rate. In consequence, we have accumulated in Montana during the past 25 or 30 years almost a million acres of forest lands that are more or less in a condition of non-production. These million acres of waste lands are a burden to every community in which they exist. They threaten to limit the state's industrial development and expansion. They must be recovered, reforested, and protected from further devastation. They must be made again to grow timber for our mines and farms, for watersheds that assure power and irrigation. The history of forest depletion in the east must not be repeated in Montana. The experiment is too costly. Forty million dollars a year freight bills for imported lumber is the price paid by some eastern states for having formerly been reckless and careless with their forests. It isn't sound business for those regions adapted to growing timber to have to import lumber. With these 500,000 acres of State Forests, we can not afford to be careless. They compose a valuable part of the public lands of the state, to be paid in trust for the people of Montana. The proceeds from this property, as prescribed by the enabling act, and the state constitution, go wholly to the benefit of Montana's institutions. While every citizen of the state is indirectly benefited by the State Forests, the chief and direct beneficiaries are Montana's educational institutions.

A STATE FOREST CUTTING

Piling and burning the slash is a practical method of preserving the young timber.

DISTRIBUTION OF RECEIPTS FROM SALES OF STATE TIMBER CROPS FOR THE PERIOD COVERED BY THE STATE FORESTER'S SEVENTH BIENNIAL REPORT.

Institution—	**Amount.**
Common Schools	$ 71,627.61
Agricultural College	19,688.62
Agricultural College Bonds	19,365.33
Deaf and Dumb Asylum	9,008.29
Capitol Buildings	111,867.63
School of Mines	21,444.25
State Normal School	28,538.37
State Reform School	1,586.34
University	936.26
	$284,062.70

There should be some direct contact between the representatives of these different beneficiaries and the State Forestry Department, which has the management of this trust estate. That contact should possibly be in the nature of a Board of Advisors to the State Board of Land Commissioners, and the State Forestry Department. Such a board could be composed of ex-officio members of these state institutions, with representatives from the lumber industry, authorized by law to confer and advise with the State Board of Land Commissioners and the State Forester, upon matters of policy affecting the use and management of the State Forests. A degree of permanence in policies of State Forest use and management could thus be established, uncolored and unaffected by changes in the political complexion of the State Board of Land Commissioners. The importance and value of the State Forests as a trust estate are too great to be left to the chance of politics. The proper use and consequent returns from the State Forests involve principles of management which require decades and generations to mature.

Consolidation of State Forests.

In settling down to permanent ownership of forests and forestry practice, the State should endeavor to exchange its scattered forest holdings to secure compact forest units. There are still available approximately 100,000 acres of State Forest tracts, both surveyed and unsurveyed, within the exterior boundaries of the National Forests that should be exchanged for federal lands of equal area and equal timber value. The State is not justified in accepting in lieu therefor lands unlike in character or of lesser timber value.

The landscapes of our lakes and streams are a joy to every real Montanan.

State Forests Created.

"To the end that the same may be controlled and managed as a State Forest" (Revised Statute, Sections 1907 and 1908), the Stillwater-

The young timber must be preserved. The watersheds must be kept intact if we want to develop those two million acres of farm lands possible of irrigation, and the full capacity of our hydro-electrical power development.

Swan River units were each selected and secured for future benefit of Montana's public schools. For the benefit of other educational institutions of the State, other compact forest units have from time to time been selected, so that at present the chief State Foress may be designated and summarized as follows:

Name—	Acreage.	Quantity of Timber.
Stillwater State Forest	89,000	700,000,000 Ft., B. M.
Swan River State Forest	40,000	425,000,000 Ft., B. M.
Coal Creek State Forest	18,000	170,000,000 Ft., B. M.
Ross Hole State Forest	10,000	75,000,000 Ft., B. M.
		1,370,000,000 Ft., B. M.

Extension of State Forests

The State Forests of Montana will inevitably be enlarged and extended. This extension will probably come about most rapidly by the acquisition of cut-over lands. The State's responsibility to keep these cut-over lands productive and producing is vital to its existence and prosperity. The cut-over lands in private ownership are growing at the rate of about 40,000 acres a year. That portion of these cut-over lands not adapted to agriculture must be kept in condition to grow timber. Private owners of timber land in Montana cannot be held responsible for reforestation. Reforestation is a public enterprise and belongs to both the State and the Nation. In this work the State must do its share. To that end the following bill was introduced in Congress by Senator T. J. Walsh, and approved February 14, 1923.

"Sec. 1878. That tracts of timbered lands heretofore granted to the State of Montana for educational purposes, from which the timber has been cut or removed pursuant to State laws, may, under such rules and regulations as the legislature of said State shall prescribe, be exchanged for other lands of like character and approximately of equal value, in private ownership, which exchanged land shall be subject to the same requirements and limitationt to the end that the State may acquire holdings in reasonably compact form and reforesting be undertaken in an economic manner, anything in the enabling act of said State to the contrary notwithstanding."

FIRST DAY IN THE FIELD

Aches on the right of me,
Aches on the left of me,
Kinks in my backbone
That cripple and grieve me.
When shall my movements be
Filled with spontanity,
Where shall I find a balm
That can relieve me?

—Clipped.

FACTORS IN THE GEOGRAPHIC DISTRIBUTION OF PLANTS

By J. E. KIRKWOOD.

The distribution of plants in nature is guided and controlled by natural forces. To the casual observer certain facts of distribution are quite obvious, and the amount of his knowledge in this direction may extend to considerable detail if he has traveled widely. To the popular mind the obvious facts of geographic distribution are of interest mainly from the standpoint of their manifold relations to prosperity and life. While these things are apparent to the scientific mind, to a degree even greater perhaps by reason of training, certain other considerations command attention, having to do with the causes of distribution and the reasons for the facts as we find them today.

Why one might ask, is a certain species restricted to a single mountain peak while another and very similar one covers a continent? Why is one species cosmopolitan, ranging over half the globe, while another member of the same family, similar in appearance and habit, is found only in a small area? Why is the hartstongue fern found only in a few widely separated and very limited localities in North America and nowhere else nearer than central Europe? Why do some of our forest trees native to the Atlantic states find their nearest relatives in eastern Asia? Why, to come nearer home, does one of our pines occupy but a limited area in western Montana, northern Idaho and parts of the Cascade and Sierra Nevada mountains, while another, associated more or less with the former, extends its range over nearly half of North America? Such questions might be multiplied indefinitely and have long absorbed the interest not only of the botanist but of the zoologist, geologist and others in various branches of science and philosophy. Darwin drew upon the facts of distribution in support of his theory as to the origin of species and today Willis, an English scientist, employs the same materials in a contention as to the course of evolution directly opposed to the Darwinian view.

When one considers a species of very limited range he may reach one of two conclusions concerning it; either the species is a surviving remnant of a waning race, or is a new originated form which as yet has not had time to stray far beyond its birthplace. The element of time is always an important consideration, since the migration of plants from generation to generation and from year to year proceeds in accordance with the habits of the organism and the nature of the environment. We must regard the progress of a plant in its dispersal as representing the result of contention between the forces within it making for survival and extension and those without which oppose its survival and extension. It may be that a fortunate coincidence of reproductive vigor and lack of opposing forces will enable a plant rapidly to extend its sway over great areas, or, on the other hand, the development of unfavorable conditions may operate to reduce to the point of extinction a race once widely dominant. Thus the solution of problems of geographic distri-

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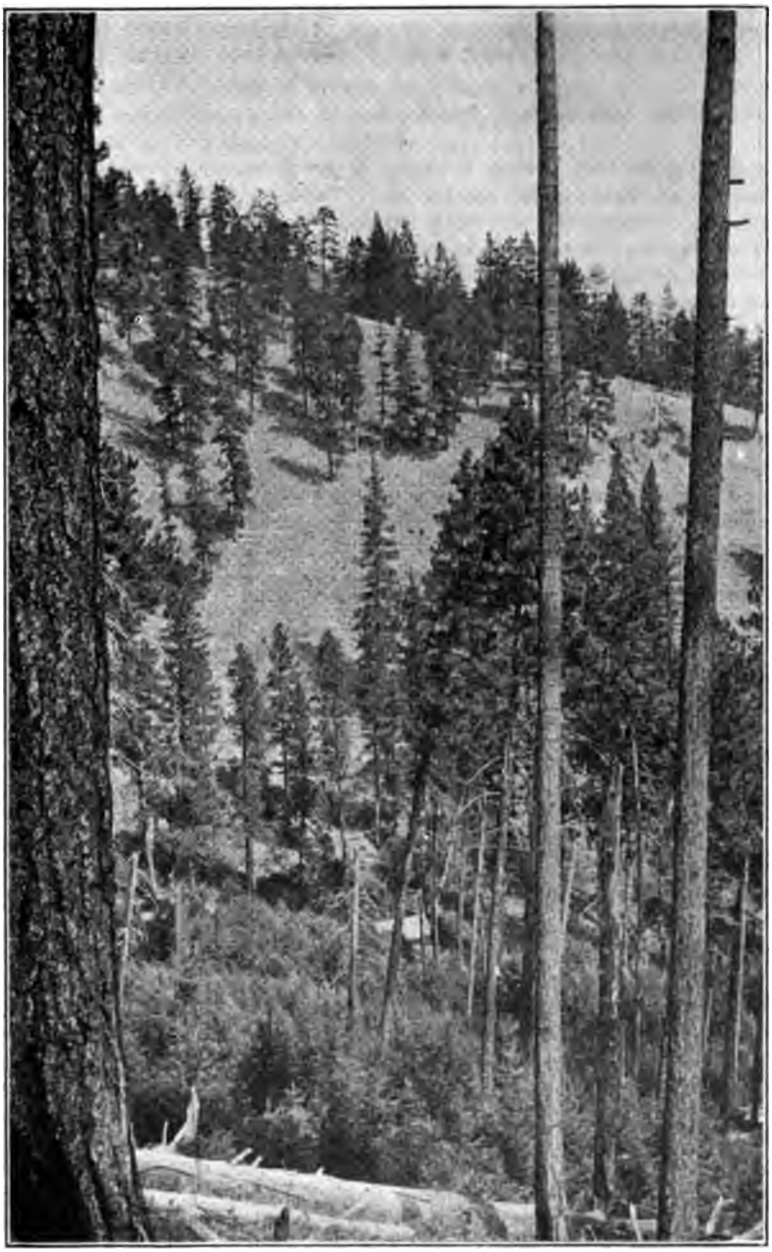
bution in many cases can not be found in existing conditions, but must lie far back in remote periods of geological history.

The geologist and the paleontologist have been mutually helpful in penetrating the history of the past. The geologist determines the age of the rocks and the sequence of the formations, while the paleontologist discovers in fossil leaves, stems and other parts of plants a clue to the vegetation of the earth millions of years ago. Not only is this true as to the identity and relationships of the plants of those times, but also as to the climatic conditions under which they grew. From such evidence we learn of the former circumpolar distribution of Magnolias which now in the northern temperate latitudes are confirmed to eastern North America and eastern Asia. Similarly from the skeletal remains of animals, even if no vegetal relics are found, accurate inference may be drawn as to the character of the plant life. From what we know of the habits of such animals we associate horses with prairies and deer with forests, and by the structure of the teeth it can easily be determined whether the animal was of the browsing or the grazing kind and whether his food was of soft shoots or of harder stems such as grasses. From geology we also learn of the past configuration of continents, of uplifts of land masses and of their subsidence below the sea, of the coming and going of the ice age, all of which played a very profound part in determining both the nature of the present vegetation and its distribution.

At one time a broad land bridge connected the Asiatic and American continents. During much of this extended period a mild climate obtained far to the north. Fossils show that many trees now confined mainly to the latitude of Virginia and southward grew freely in Canadian latitudes. The gold-bearing gravels of northern California yield remains of Magnolia, sweet gum, prickly ash, and holly, not now indigenous to the Pacific Slope, but found in the southeastern states, also the fig and oaks of the present Mexican kind now found only much farther south. From these facts it appears that northern California then had a climate about like that of the Gulf region of today.

This was a period of extensive migrations of the forest flora eastward across the Eurasian continent and North America. It was a rich flora and covered extensive continental areas with hardwood genera, such as beech, walnut, sycamore, oak, hickory and many others, as revealed in fossil beds widely distributed over the plains of eastern Montana, Wyoming and Colorado and far removed from the range of these trees at the present time.

With the coming of the glacial age came also an elevation of the land which must have augmented the frigid conditions. The California coast was 2,000 to 3,000 feet higher than at the present time. Much of the northern flora was destroyed. The continuous ice sheet swept the ground clear. Some species apparently migrated southward with the changing conditions and were preserved, while most of them succumbed to the advancing cold. In North America the high mountain ranges lie generally north and south, which permitted migrations southward. On the Eurasian continent their direction is mainly east and west,



SCENE IN THE BITTER ROOT MOUNTAINS.

Exposure toward the south, grassland and scattering yellow pine. In the ravine, young pines and Douglas spruce.

which resulted in the extinction of most of the broad-leaved trees when the ice sheet almost literally crushed them against the barrier, which accounts largely for the poverty of species in the European hardwood forests at the present day. Subsequent to the glacial period the plant life which had been driven from the north reclaimed to a large extent the devastated area slowly, little by little, in successive waves. Some species with light seeds carried easily upon the wind have already reached their most northern limit, others, heavy seeded, have made headway slowly, and doubtless are still gradually extending their frontiers, notwithstanding the climatic changes resulting in drier conditions which must operate to embarrass their progress.

Direction of the prevailing winds have also been important factors. Coming from the southern Appalachian region, which was the safe harbor of many species in the stressful times of the ice age, borne on winds from the southeast, the white spruce and aspen have reached the Alaskan coast. It has been pointed out that the forest vegetation of Nebraska entered that state from the southeast. Many plants have entered Montana from the same source, making their way up along the river bottoms. Likewise from the Pacific Coast the larger part of the flora of western Montana has been derived since glacial times, largely through the agency of the prevailing southwesterly winds. It is a significant fact that of the sixty-three woody species which have entered the Rocky Mountains from the west, twenty-seven have seeds winged or otherwise more or less fitted for wind dispersal, fifteen have small or minute seeds and twenty-one have succulent fruits with small seeds, such as may be carried readily by birds. Among the plants derived from the west there are no heavy seeded species unless the white bark pine be excepted, which has seeds without device for wind conveyance, but which are known to be carried by birds. Oaks grow in Oregon and Washington but none of them have raeched the northern Rockies, nor have any arrived from the Mississippi Valley, which is the home of numerous species of Oak in great abundance. Nor is it because the oak cannot grow in this region, for several vigorous specimens flourish on the University campus.

Forest conditions are more prevalent and the plant covering denser on the Pacific Slope of the Rocky Mountains than on the eastern side, which is clearly the result of climatic conditions of the present, but the greater richness of the flora calls for another explanation. The greater diversity of the topography between here and the Cascades and the fact that the distance is less than half that across the plains eastward from the summit of the continental divide probably accounts for the dominance of the North Pacific element in the northern Rocky Mountain flora. In this matter we should consider the fact that formerly, after the retreat of the ice, the Great Basin reaching north into eastern Oregon and Washington and now semi-arid, was then occupied by the large lakes and a far more humid climate prevailed, which favored the *eastward* movement of species.

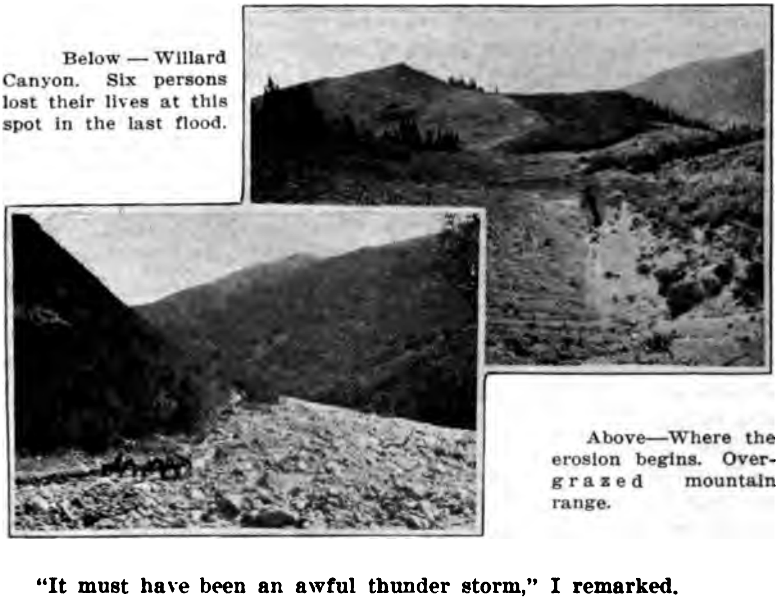
The principal refuge of western species in glacial times was in

(Continued on Page 67)

FLOODS IN UTAH

By FREDERICK S. BAKER
U. S. Forest Service, Ogden, Utah.

We had some floods down this way last year. Perhaps you read about them in the newspapers. It started to rain like everything one evening and presently down came disaster, hitting particularly the little towns of Willard and Farmington, in both of which there was loss of human life and a big property loss. These floods did not start on National Forest land, for which we are duly thankful, but just the same we Forest Service people have been interested in floods down in this part of the country for so long while dealing with National Forest situations that I was anxious to find out what caused these floods in Willard and Farmington; accordingly, I went and asked, this seeming the simplest solution of my difficulty. It wasn't long before I found out. I was up at Willard talking to a fine old lady who told me about how the water came down through town.



Below — Willard Canyon. Six persons lost their lives at this spot in the last flood.

Above—Where the erosion begins. Over-grazed mountain range.

"It must have been an awful thunder storm," I remarked.

"Thunder storm," she said, "why it wasn't any thunder storm at all, it was a cloudburst. The cloud ran right into the mountain and was torn open and all the water came tumbling out."

"Oh!" said I, for that was about all the occasion called for.

A few days later I went down to Farmington and was discussing the flood down there with some people who had seen it.

"Do you *want to know* how the flood started," said one man. "I *was right out watching* the whole thing. There came a tremendous storm

up from the west. Sort of a water spout formed out on the Great Salt Lake, and a solid column of water rose right up out of that lake and went right up over town here and came down on the mountain. I saw it go."

"Was it salt water that fell?" I asked.

"No," said he, "it was fresh water. I don't understand how nature separates the water from the salt—but, anyhow, I saw that water go right up out of the lake and come down on the mountain."

"Uh, huh," thought I to myself, "here we learn some more." I pursued my investigation further.

Another gentleman said to me, "Do you know what made that flood?" I told him I didn't, but was willing to be enlightened.

He said, "Well, it's just like this, you see that there hadn't been any flood in that Canyon for years and years. The bushes and trees grew right down to the stream channel and clogged it up. When this rain came the water couldn't run off. It gathered together up there in the mountains and matted together all this brush and stuff and got dammed back. When she burst, she came down through in a tremendous flood. But now the channel is good and clean again and we won't have any more floods for another 40 or 50 years."

"Oh!" said I, "I'm glad to know." And still I continued my pursuit of knowledge.

"Do you know what caused the flood?" asked another man, "why, it was the nature of the country. It was so steep and rocky that the water just came off of there as it would off a tin roof and so, of course, there was a flood. Naturally had to be."

"Yes," said I, "sounds very probable."

It was very obvious that an open season had been declared on flood theories. Every man was entitled to unlimited bag and seemed to be out to do his best.

Said I to myself, "Why not make a collection of these wonderful products of the human brain and see what they look like? It ought to be fully as interesting as collecting antiques or postage stamps."

Now, I knew that down at the Great Basin Experiment Station of the Forest Service they have been studying this sort of thing for some time and I thought to myself, "Well, maybe the Director down there can tell me something that will add to my collection of curious ideas regarding these disastrous floods."

It happened that soon I went down there to the Experiment Station and I said to the Director, "You know these floods we had this summer up here in Utah,—well, what started them?"

He is a true scientist and showed his scientific training in his answer.

"I don't know," said he. "But," he continued, "I have some ideas *about* the factors that modify the floods, that make them serious and destructive or not at all bad. Listen here."

Well, I listened to the long, long tale he told me, and it certainly was very interesting. This is the story:

AFTER THE FLOOD.
Power house at the mouth of Willard Canyon.

The Manti Forest, in the good old days when National Forests were just new, was cursed with an extraordinary number of floods and 'way back in 1910 an investigation was made to see what caused such destruction down in that part of the country every time it rained a bit hard. The results of this investigation are given to the world in Forest Service Bulletin No. 91, "Grazing and Floods." The very title tells what the results of this study were. The man who did the looking could see grazing as the chief influence governing the floods. But you take the average low brow and the words of a scientific observer like this Forest Service man do not count for very much more than the word of a man who sees the Great Salt Lake whirled up in the sky and dumped down on top of a mountain. So while this bulletin did a lot of good and caused certain beneficial changes in grazing practice down in that part of the country, it wasn't entirely convincing. Nobody knew exactly how much influence grazing had on the flood situation. Some people thought it had a lot to do with it, others thought it didn't amount to much. So presently, when in 1912 the Great Basin Experiment Station was established on the Manti National Forest, it was decided to investigate the relation of grazing to floods at once.

The Manti National Forest lies on a plateau of sandstone and limestone rock—soft and easily weathered. In the flanks of this plateau, streams have eaten back canyons which are typically narrow in their lower courses but right up at the top where they meet the main range they suddenly spread out into broad fan-shaped basins. Lots of people have thought that it was merely the shape of these basins that caused the floods, the waters being caught here to be shot down through the narrow canyons just like home-brew going through a funnel. The stream beds tell clearly enough that the flood damage starts away up there, but just why they start there isn't so easily told. Accordingly, when they

came to investigate the matter, they decided to study it up in these basins. At the head of Ephraim Canyon two nice wedge-shaped segments of the fan-shaped basin were selected—10 acres in each. These wedges of country were fenced in and down at the foot where all of the gullies came together, settling tanks were installed, fixed up with weirs, so that after every storm it would be possible to tell how much water came down off the ten acres and how much rock and sediment was brought down with the water, as this would be left in the settling tank. These tanks were made good and large, but you've no idea how the water runs down off those hillsides when it rains hard, and they presently had to be enlarged. At the present time one of these tanks is 36 feet long, 12 feet wide and 4 feet deep; and the other about 24 feet long, 6 feet wide and 4 feet deep. Ths big one has been chock full after one single storm, at that.

Now, this being a highly scientific undertaking, it had to be done just so—no fooling around, judging by observation, etc.—everything had to be measured and checked and fixed up right. So first of all these two areas that were chosen had to be compared with each other for a period of five years so that the normal relationship between runoff on the two could be judged, the areas being grazed and treated just the same during that period, for the two areas were not exactly alike. One area known as "A" had a deep gully running down the middle of it with a number of side feeders coming in; the other one—"B"—had a lot of parallel gullies which did not meet until they were down at the settling basin and weir. Of course, the runoff on the first was a good deal greater than on the second because the water tended to gather together in a single channel and get a good shoot down to the settling tank; whereas in the other it had to flow through small, narrow, crooked channels and a great deal more of it was absorbed by the soil and erosion was much less severe. Still five years ought to fix pretty definitely the relation between the two under equal grazing. So five years went on with only one thing to report. It was in 1919, the fifth years of the experiment, when on the second of September black clouds rose in the west in the afternoon and presently BANG! A tremendous storm burst on the top of the mountain. It rained good and hard for eleven minutes, .35 of an inch of rain falling during this time on the area. The water came rushing down off the slope, especially on area "A," and filled up the tank with rock, stones, and mud. Indeed, it came down so fast off that little ten-acre area that the weir at the lower end of the tank was unable to carry off the flow although it's a triangular affair 18 inches deep. The water rose up above this weir and flooded the little house over the tank and finally got up enough pressure to burst open the barred doors at the end of the building; whereupon it shot out with a tremendous rush. Thus it happens that nobody knows exactly how much water came down that day, but they do know the amount that *was* measured and they do know that it was less than the total amount *that ran off.* Well, that storm of 1919 went down in history and was placed on the records along with the rest. But you remember it; for thereby hangs a tale. During the years after 1919 the two areas "A" and "B" were treated differently. "A"—and this was the area which had the big gully down through the middle and was in the worse condition—was treated with respect and protected absolutely against all grazing, while "B" continued to be grazed in the same old way. Time went on and heavy storms came, washed earth down on both areas, and the records were taken and put down on the books. It was obvious it was going to be a pretty hard thing to tell just what the differences were even with a good experiment like this, because it is so hard to judge the effect of intensity of storms. It had been so far impossible to correlate runoff and erosion with rainfall in any kind of a way because the intensity and the duration of the storm, etc., cut such a tremendous figure. Well, things went along like that until August 13, 1923. That was the date when the big storm occurred which caused the floods in Willard and Farmington Canyons and did so much damage in the north part of Utah. A rain came down there at the experimental area, too—and Fate played a pretty trick. Usually when Fate sticks a finger in things it usually succeeds in doing you dirt, but this time it did something that helped out a whole lot in interpreting the results of this experimen. It condescended to rain just exactly as hard as it did in 1919, and, furthermore, it rained easy a while before the main storm burst just as in 1919, and wet the ground up so the soil conditions were the same. In 1923 it kept up the rainfall at the rate of about .03 of an inch a minutes for 23 minutes, .72 inches of rain came down, almost exactly twice what occurred in 1919. Well, now, let's just compare the two storms on the area "A." You remember this is the area that in 1919 had been grazed steadily until that time; since that date—four years—it had been protected and the amount of forage cover on the area had increased a good deal although, to tell you the truth, it's no flower garden even now.

Now look here at this tabulation:

	1919	1923
Intensity of the rain	.03	.03
Duration of the rain	11 min.	23 min.
Amount of water falling on ten acres (Cu. feet)	12,705	26,136
Runoff (Cu. feet)	8,992	5,924
Sediment eroded (Cu, feet)	2,354	845

To put it briefly, it rained just as hard in 1923 as in 1919 and twice as long, but in 1919 70 per cent of the water ran off while four years later only 23 per cent of the water ran off, futhermore, there was only about one-third as much erosion in the second storm as there was in the first. This, stated very mildly, is certainly striking, so striking that it is most unbelievable that such a great difference could occur in such a short time. No trees have grown up, no shrubs have come in on the area, the improvement is only by the spread of grasses and herbs. Those who have been on the ground in a heavy storm say that it seems to work like this: The weeds and grasses break up the drops and prevent them from falling right on the naked soil, the roots are also binding the soil together and making it less subject to erosion and the plants are coming *in the channels and* preventing the free movement of the water. One of the most remarkable agencies seems to be the wild dandelion, scientifically known as Agoseris. This little plant, that doesn't seem to amount to anything, looks a good deal like a dandelion, but the leaves instead of being cut up fancy are of a plain and simple design. When the rain comes, these leaves, which are rather limp, anyway, lie flat down on the ground in a rosette, protecting the soil and keeping the drops of rain from striking on its loose particles. It is believed that a good part of the improvement is due to this.

There are, of course, "Doubting Thomases" that wouldn't even agree that this was conclusive. They think that the rain fell in bigger drops in 1919 than it did in 1923, or that in 1923 the wind blew so hard that it kept the water from running down hill, or some such thing as that. In order to demolish these unbelievers it is only necessary to turn to our check area, area "B," that has been grazed ever since the initiation of the experiment nine years ago. What happened there in these two storms? Well, that is where Fate got in her dirty work. It so happened that area "B," the check area, had just recently been grazed in 1919. In the year 1923 the herd of sheep had not been over it yet. Accordingly the figures don't read very well because the sheep always make a great deal of difference in runoff and sediment. Soon after they have gone over the ground it is hard packed, runoff is greater and at the same time the loose dirt worked down into the bottom of the gullies is washed off and erosion is greater. Thus the results in these two particular storms do not check well on area "B." At the same time it is possible to circumvent the evil machinations of Fate in this case and by looking at the averages of the years to see how area "A" had improved in relation to area "B" in that length of time. When the two areas were being treated alike, erosion and runoff was a great deal worse on area "A" than on area "B," as already mentioned. Now it is only a little worse. The improvement is marked. The relative runoff has been reduced 36 per cent, the amount of sediment eroded has been brought down 60 per cent and the muddiness of the water, that is, sediment per hundred cubic feet of run-off has been reduced 38 per cent during the three-year period since grazing has been stopped on area "A."

Now, of course, the Great Salt Lake may have got sucked up into the sky and dropped down on top of those mountains, or a cloud may have bumped into a sharp crag and got ripped open and all the insides may have fallen out, or, again, the stream channels may have got so clogged up with brush and trees that the water couldn't run down properly, just as these flood theorizers told me. Still, taking all that into consideration, I sort of lean toward this grazing business. A nine-years' look into the conditions is certainly more reliable than one that lasts about nine seconds, and nine years of thought on the problem are probably somewhat superior to nine minutes, so personally I have taken quite a liking to the theory that destruction of herbaceous cover cuts a big figure in making bad floods. I do not believe that the floods are entirely caused by range conditions but that they are certainly influenced a whole lot by them. So I've taken this and given it the place of honor in my collection of theories as to how floods start. You, of course, may do anything you choose.

END OF THE SEASON

The rabbits an' the weasels is a-turnin' brown to white,
The geese is restin' on the river bars,
The elk has started runnin', yu can hear 'em call at night
When the coyotes is a-howlin' to the stars.
The tamaracks is yellow an' the mountain ash is brown,
A mag-pie flits across the meadow bare.
The bucks has left the ridges an' they're slowly workin' down,
An' autumn haze is hanging in the air.
The fire season's ended an' we've sent the lookouts in,
A rim of ice is on the water pail.
My overalls is ragged an' my boots is gettin' thin
So I've locked the door an' hit the down-stream trail.

JACK FROHLICHER.

PUTTING IT ACROSS

By J. B. YULE
Assistant Engineer, Forest Service, District No. 1.

Did you ever, Mr. Reader, try to explain something to a group of individuals and find that your tongue didn't warble over the right phrases, and after you had used up all the gestures known in the deaf and dumb alphabet and a few more invented by the North American Indians and pawnbrokers, find that your audience was waiting with a look of expectation on its blank countenance after you had completely finished with your outburst of flowery oratory? You can see at once that your idea hasn't penetrated—hasn't even got as far as the epidermis. In other words, you haven't been able to "put it across." It's a nice pleasant feeling, isn't it? You no longer have an exaggerated idea of your own importance; you feel as though a thimble could be used as a hat and would come clear down to your shoulders if used to cover your brain, and not your head. It's an elevating feeling, isn't it?

Well, as I started out to say, if you have ever been afflicted with these symptoms, come over here and I'll let you in on a little secret that dates back somewhere between the birth of King "Tut" and the Garden of Eden. If you ever want to explain an idea to a group and have it thoroughly understood, draw a picture of it on a green cheese box. It is not necessary to be a skilled artist in order to illustrate an idea. Any bunch of hieroglyphics that will anywhere nearly resemble your idea will do. But the sketch, if crude, must be complete. Don't be like the foreman of a logging camp who couldn't write and ordered all of his supplies by the illustration or picture method. One day he ordered a grindstone and received a cheese instead, simply because he had forgotten to put a square hole in the center of the circle.

Away back in the primitive ages when the human mind was in its infancy of development, the eye was able to photograph on the retina the same beautiful pictures that it does in these modern times. Ages before thoughts of men were conveyed by the written word they were expressed by pictures, crudely carved or drawn on rocks and other suitable materials. The same practice is still in vogue among barbarian and savage tribes.

So we have inherited the graphic method of illustrating those ideas which are too complicated to be transmitted either by spoken or written words. Try and describe two similar people so that they can be identified in a crowd, and you will find how complicated the task really is. Then try to identify them by their photographs and you will be surprised to learn how relatively easy the task becomes. This little illustration will serve to demonstrate why it is so much easier to express our ideas in a graphic way than by means of words.

And so our text-books are supplemented by diagrams, sketches, and charts; our stories are illustrated by pictures and drawings and our newspapers by cartoons and cuts. Even our best books and stories are worked over into moving pictures. Plans are made by the architect and road-builder and in numerous other ways the graphic method is used with a single purpose in view, and that purpose is to assist the human mind in visualizing an idea.

The majority of readers of this article are probably interested in one of the most critical problems which today faces the American people—Forestry. The big "Forestry idea" must be "sold" to as many of our neighbors as possible if we are to enjoy the advantages of a perpetual timber supply. And what is the best method of selling? It is by painting a clear mental picture for our neighbor, that he is able to visualize and retain the idea we wish to convey. As has been explained above, this can best be done in a graphic way. The use of moving pictures, posters, cartoons, window displays, photographs, sketches, drawings, maps, designs, signs, illustrated talks, etc., is essential to demonstrate the graphic method. The successful advertiser has the country flooded with pictures of his idea so that through repetition it becomes indelibly stamped on the mind. So must a picture of the Forestry idea be indelibly stamped through repetition on the minds of the American people.

It should be the duty of every man and woman connected with any of the many phases of Forestry work to be of service in this great movement. In every Forest activity there is an opportunity to explain to some member or members of the public some of the advantages of that activity.

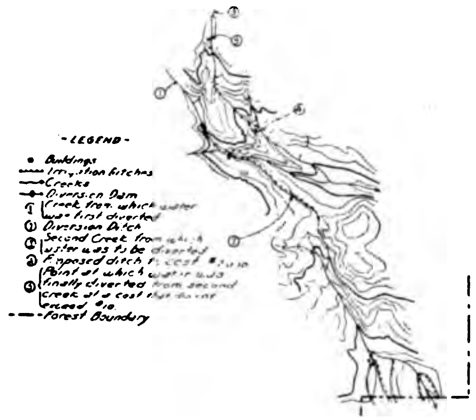
As my particular line of Forest work happens to be making maps and surveys, I am going to relate an incident or two which will demonstrate how it is possible to sell ideas to the public in connection with this activity.

A few years ago public sentiment was pretty strong against the United States Forest Service in many of our Western National Forests, and I happened to be in charge of a topographic survey party on one of these Forests. Now, making a map is simply reproducing on paper a miniature of what exists on the ground. It is a graphic way of picturing the topographic and cultural features of a given area.

Our party was camped in the foothills near the Forest boundary and adjacent to a large ranch The rancher, who happened to be a very influential citizen of this locality, had become embittered against the Forest Service, and largely through his influence the whole community was likewise embittered and our party was as popular as the mumps. It also happened that this rancher had diverted water from two small forest streams for irrigation purposes. During the summer months the water supply was still inadequate to irrigate his lands and he desired to divert the water of a third stream. One Sunday he came to our camp to get a surveyor to run a ditch line in order to determine the location, length and cost of the proposed ditch. He was "hard boiled" and surly, and didn't mince words in saying what he thought of the government and its employees, even while asking favors. He received courteous treatment, and it was soon discovered that he expected it would cost him $2,000 to bring the ditch around a hill to a point above his diversion dam on one of the other streams. By consulting the topographic map which we had completed for this area I found that an old channel of the third stream passed through a low, swampy "saddle" and joined one of the other streams several hundred feet above the diversion dam. It took one day with a team, plow and scraper to divert the waters from the new channel back to the old. According to his own estimate our graphic method of picturing or visualizing conditions to this hostile rancher had saved him $2,000.

You can most generally influence a man by hitting him in the pocketbook, especially if you strike in the right direction. Courteous treatment and a probable saving of $2,000 changed the attitude of this entire community through its "ring leader" or "king pin." Before we finished this project, ranchers became so friendly that they even invited us over to help milk the cows, which all goes to show how an idea can be sold by the graphic method.

The accompanying map will assist the reader in visualizing the conditions described above relative to the rancher's irrigation system.


- LEGEND -
● Buildings
Irrigation Ditches
Creeks
Diversion Dam
① Creek from which water was first diverted
② Diversion Ditch
③ Second Creek from which water was to be diverted
④ Proposed ditch to cost
⑤ Point at which water was finally diverted from second creek at a cost not to exceed $10.
Forest Boundary
①
②
③
④
⑤

About ten years ago a prospective timber survey of one of the largest and finest virgin stands of white pine timber to be found on any National Forests necessitated a topographic map to govern logging engineering, appraisal and estimating activities. The area had not been surveyed by either the U. S. Geological Survey or the General Land Office. A transit party was started on the area in mid-winter in order to establish known points from which to initiate topographic mapping and estimating operations at a later date. Transit traverses were run along ridges in a manner that would control logging units by watersheds or drainages. The survey party worked on snowshoes and on the higher ridges the snow was from 15 to 20 feet deep. Camps and provisions were moved by the backpacking methods or on man-drawn toboggans. There *is a lot of grief* and profanity connected with this method of transporta*tion. (If there* happens to be any doubt in the reader's mind as to whether or not this statement is authentic, please ask the man who has tried it. If you have been so fortunate as to have had experience along these lines it will not be necessary for you to ask anyone.)

In the spring, topographers and estimators followed the survey party. Points along the survey line were perpetuated by stations marked on trees. It has previously been stated that the survey was run over 15 to 20 feet of snow, and when the snow melted in the spring, the stations were left "dangling 'high and dry' 'up in the air.'" If the estimator or topographer was so thoughtless as to leave his "sky-hooks" or "climbing-irons" in camp, he had the satisfaction of "shinning" up a few pitchy trees in order to determine the number of the control station from which he expected to start.

In order to obtain a more uniform estimate, the area was divided into units in such a way that estimators' lines would cross-cut or run at right angles to principal drainages. Estimates were made in units of 40 acres designated by numbers and letters in much the same manner that the French people have of identifying blocks or units by the coordinate system. When the project was completed, the irregular shaped units took on the appearance of a puzzle map of the United States. Have you ever taken a look at some city map where the original idea was to lay out blocks and lots in cardinal directions by the rectangular system, and that some "addition" (there is very apt to be more than one) has been placed in at an angle to the main scheme so that when buildings are eventually constructed on the resulting triangular lots, the famous "flat-iron" building is obtained. If you gather the beautiful thought resulting from this description, you will have no difficulty in visualizing the appearance of our irregular timber survey units. (I would illustrate this situation with a sketch, but a ban has been put on the idea of using over one cut on an article of this size.)

After the field work on this project was completed, the timber on the area was advertised for sale. Practical timber men flocked in to get a look at the survey of the area and obtain information on the amount of timber, factors influencing the cost of logging, methods of transportation, etc. Then the fun began. Why? For two reasons:

(1) We trotted out a topographic map when Mr. Logger wanted to get a look at a hachure or relief map (something he could understand); (2) Mr. Logger wanted to know how much timber there was on the N.E. ¼ Sec. 10, and we tried to tell him in terms of Block A, line 1a, 2b, etc. We talked in different languages. Can't you see how discouraging the situation must have been at that time to the man whose business was producing lumber and not studying specialized methods of surveying and mapping? Today the situation is different, because the lumberman and timberman is waking up to the importance and value of modern and scientific methods in all phases of the industry.

Please remember, Mr. Reader, that there are few ranchers, lumberjacks, stockmen or workmen of various trades and professions that are not able to talk and understand in terms of sections, ranges and townships; in other words, the rectangular system of government land sur-

veys. So if you are trying to sell them a survey idea, capitalize on their idea of surveying. In like manner, talk to the astronomer about constellations and the stellar system; talk to the lumberjack in terms of cant-hooks and peevies; the stockman in terms of grazing, "dogies," slick ears and "cayuses;" the dentist in terms of extractions, crowns and inlays. In other words, when you are trying to get some idea "over" to an individual or group of individuals, cater to the things that are of interest to them and capitalize on their knowledge.

As a summary, I would like to say, if you have an idea, try and explain it by lingual methods; if not successful, whistle it; if still unsuccessful, draw a picture of it on a green cheese box. That'll get 'em.

WHATEVER YOU ARE

If you can't be a pine on the top of the hill,
Be a shrub in the valley; but be
The best little shrub at the side of the hill;
Be a bush if you can't be a tree.

If you can't be a bush, be a bit of the grass,
Some highway to happier make;
If you can't be a muskie then just be a bass;
But the liveliest bass in the lake.

We can't all be captains, we've got to be crew.
There's something for all of us here.
There's big work to do and there's less to do,
And the task we must do is the near.

If you can't be a highway, then just be a trail;
If you can't be the sun, be a star.
It isn't by size that you win or you fail—
Be the best of whatever you are.

—Clipped.

SOME CAUSES, EFFECTS AND REMEDIES

By HOWARD R. FLINT

Probably there is no question more often put to the forester in the Northern Rocky Mountain region than the innocent query: "What causes all these forest fires, anyhow?" The answer can mean but little in any particular place unless it is localized to cover just that immediate territory. The causes are many and they vary considerably with climate and human activities, both of which, in the mountain region, are very much localized factors.

Speaking for the region as a whole, the answer, reduced to its lowest terms, can be expressed in two words. The words are "people" and "lightning." Two-thirds of all the forest fires that occur in the region are due to human carelessness or to human "cussedness"—chiefly carelessness. Really but very few fires are due to downright cussedness. The percentage of fires due to each of the two main headings, people and lightning, shows about the widest possible variation within comparatively short distances.

In the relatively uninhabited National Forests of Central Idaho just about 98 per cent. of all fires are caused by lightning. In certain more populous localities in Montana and Idaho, particularly at the lower altitudes, as high as 90 per cent. of the fires are due to human agencies.

Perhaps no other region in the world is so destructively inflicted with lightning-caused fires as is the Clearwater River drainage in Idaho. Several causes combine to bring about this unfortunate condition. In the Clearwater region lightning is of most common occurrence in the months of July and August. During those months there is usually a negligible amount of rainfall and all forest material becomes very dry. Coupled with this condition is the fact that the timber stands are generally very dense and all of the tree species and some of the shrubs carry a great deal of highly inflammable resin, thus encouraging the rapid spread of any fire which gets started. What is true of the Clearwater locality is also true in a somewhat less degree for nearly all of Northern Idaho and for Montana west of the Continental Divide.

There is, however, no reason to believe that lightning is any more or less prevalent or potent now than it has been in all of the years and centuries gone by, and still goodly areas of splendid old forest survive in the heart of the lightning region. While lightning is still a great cause of forest fires, and on occasions causes the burning of vast areas, it is less destructive than might be imagined because so much of its effect occurs at high altitudes where really first-class timber is rarely found. Then, too, in one respect a fire in the mountains somewhat resembles the ambitious youth who aspires to achieve large things. To be really successful, both must usually start near the bottom. Many, although by no means all of the lightning fires, start near the tops of the hills and ridges and must of necessity spread downward to cover any great area. For very simple and well-known physical reasons fire usually travels but lamely down hill though it mounts the ascending slopes with a rush.

For the present at least the origin of the lightning fire is as little subject to human command as is the thunderbolt itself. Like the situation with reference to certain other elemental things we must prepare to meet it on its own terms. The things of importance are that we become fully informed as to the terms, that we really prepare, and that we meet it promptly and with the utmost vigor.

Many an "old-timer" whose residence in the Northern Rockies antedates the beginning of forest protection in the region has demanded of the forester an explanation as to why the forests did not all burn up years ago before they had even first aid? Here the answer is not "people," but rather the absence of people.

It is a well-known fact that the Indian population of the region was very sparse and that they spent a large part of their time in the lower, open valleys where the forest fire danger was slight. We recall that two-thirds of our present-day fires are man caused. Most of the causes can be directly traced to industrial activities. Railroads are second only to lightning as a cause of fire. Lumbering operations rank well up in the scale. The rancher clearing land and the misguided stockman who desires to improve his range by means of fire are responsible for many very destructive fires. Careless smokers cause a neat ten per cent. of all of our present-day fires, and a goodly number can be traced to careless campers. All of these causes have been introduced to the Northern Rocky Mountain forests in increasing numbers du the past forty years.

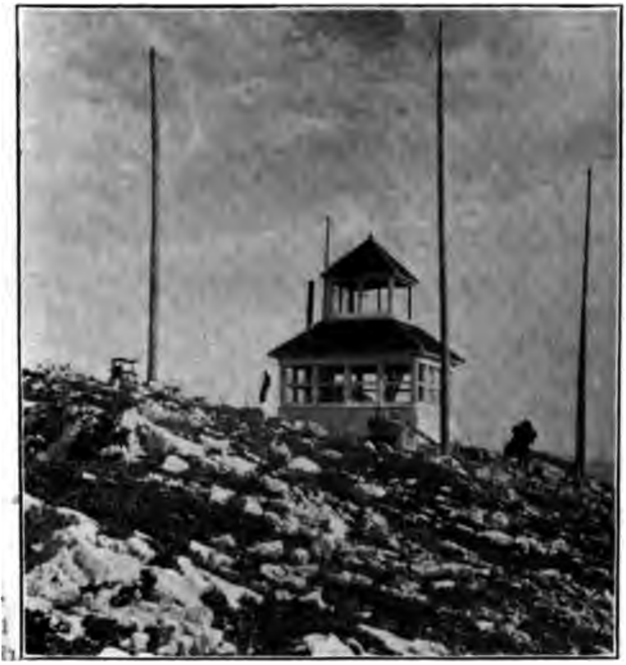
FOREST FIRE LOOKOUT MAN ON DUTY.

Telephone communication with headquarters enables him to promptly report location of any smoke discovered.

Now it must be admitted that the aboriginal Indians op ted no *railroads, they* conducted no logging operations, nor is there ason to *believe that in this* locality they cleared any land. They had matches and, therefore, no convenient or ready way in which to carry and spread fire. It is extremely doubtful if those in this locality had the wherewithal for smoking or the habit of using it. Most assuredly they were in no position to light countless cigarettes during every day of their lives and drop many of them unextinguished. If we are to believe the early explorers they used fire at times in their hunting activities and on occasion they employed it against enemies, but certainly there was no such common use of fire as we make today. Thus the forests were clearly much less often alighted.

Under these conditions the growth of wood was able subsequently to outstrip its destruction by fire and we inherited a surplus of several centuries' accumulation. Through legitimate use and needless waste the surplus and the current yearly growth are rapidly being consumed. Clearly something effective must be done if we are to avert an embarrassing scarcity of a material so universally used that during our waking hours our eyes are scarcely ever without the image of some product of the forest.

About the only encouraging feature in the situation is to be found in the fact that theoretically at least, all the man-caused fires are preventable. When we really become awake to the situation and when,



FOREST FIRE LOOKOUT STATION.

The lookout man occupies the cupola when on the watch for fires. The house is located on a high mountain peak commanding a wide scope of country. The *poles and wires* form a lightning-rod system for the protection of *the house and occupant.*

if ever, as a whole "we, the people," undertake to keep destructive fires out of the forests we can do it effectively, and we can do it at very small cost in cash or human endeavor. If each person made certain, **absolutely certain,** that no forest fire escaped from his hand, directly or indirectly, there would be only the lightning fires left to contend with and a relatively small and inexpensive organization could easily cope with them.

Unfortunately, indifference and carelessness are inborn human traits, traits which do not appear appreciably to decline in the march of human evolution. The best we can hope for, taking a practical common sense point of view, is a greater or less reduction in the number of fires that occur and the building and supporting of relatively strong organizations for the suppression of those fires that will assuredly continue to escape.

There are three evident main lines of attack on the problem, each of which must be given careful attention. Stripped to a bare statement of essentials they are:

1. The education of the public.
2. The passage and enforcement of wise fire laws.
3. The prompt and effective suppression of fires that escape.

BREAKING LANDINGS

The rollways of logs steam dry in the sun,
The Flathead is booming with freshets of spring;
It tears at the landings. The drive has begun,
For timber is needed where whirling saws sing.

JACK FROHLICHER.

RECREATION IN THE NATIONAL FORESTS OF MONTANA

By M. H. WOLFF
Assistant District Forester.

From the very earliest days of mankind human beings, to satisfy an inherent longing in the search for rest and recreation, have retired to nature. Psychologists claim that this is an inherent instinct traceable to the surroundings which were normal to our ancestors of the dim, distant past. The Bible tells us the happy home of our first parents was a garden. For ages afterward our earliest ancestors obtained their livelihood in the hunt. The hunt and the chase are pictured as the play of the ancients; no small part of the pleasure, which was not confined entirely to the killing of animals, was the bringing of the participants into natural surroundings. Our earliest childhood memories of happy hours are associated with things wild and growing, untrammeled with the restrictions of civilization. In our later years, "back to nature" is the call for recreation and health. The very color of growing plant life, green, is somehow associated with peace, contentment, and human repose. The wonders of nature and the awe of the works of God stimulate harried worldings to carry on.

As everyone knows, National Forests have been set aside primarily for timber production and watershed protection. The dominant keynote is use by and service to the people of the country whose property the National Forests are. Besides these two primary utilities, there are naturally included within the boundaries of the Forests many others which are available. Millions of sheep and hundreds of thousands of cattle are annually fed on the forage grasses that are found on the Forests of the United States. The mineral deposits in the National Forests are open for the finding and development by anyone who wishes to undertake this. The mighty streams and waterfalls are being harnessed for the development of electric power as the development of the country demands more and more of it. There are countless other uses. Principal among these are the uses associated with the recreational utilities found in the National Forests.

Lying practically at the back door of every resident of Montana is nature's wonderland, mostly in the National Forests. These Forests belong to all the people. They are managed at public expense. Even before the National Forests were created, the areas were used as vacation lands. The Forest areas are replete with wonderful mountains, cliffs, canyons, glaciers, lakes, waterfalls, peculiar formations such as caves and natural bridges and other landscape features; with unique things such as petrified trees and peculiar tree growth; with objects of scientific, historic, and archeologic interest; with timber, shrubs and flowers, game animals and fish, attractive camp grounds, picnic grounds, and summer home sites—in short, with wonderful opportunities for practically every kind of natural outdoor recreation that anyone may desire. These features are in *great public demand* and the plan of National Forest administration is to conserve them and develop them so as to make them fully available for the greatest public use. In many places their preservation and development and wise use for the purpose of public enjoyment and health outrank the primary utilities of timber production and watershed protection. In such cases the National Forest administration, when planning the development of the National Forests, aims at favoring the recreational utilities at the expense of the others if, in an isolated case, the two are in conflict.

Every year millions of people enter the National Forests of the country bent on recreation, and year by year their numbers increase. Rough records maintained by the Forest Service show that in the National Forests of Montana and North Idaho some 200,000 people used the National Forests for recreation in 1916. The period of the war held back a rapid increase in use, though a gradual increase was traceable. About 1921 there were approximately 350,000 people using these Forests for recreation alone in one form or another. In 1922 the record shows 430,000 and in the year 1923 there was a grand total of 600,000. In the State of Montana alone in 1923 the recreation visitors totaled 470,000. Of these, 440,000 were motorists who took advantage of the steady development of good roads which make the National Forests accessible by this form of transportation and thus make their beauties and benefits more readily available in these days of hurry to get somewhere. Some 320,000 of the recreation visitors were people who were not local residents but who had come from distant points on their recreational trips. Many of these latter scarcely stopped in the National Forests, but the beauties of the National Forests through which they passed were one of the principal reasons for their having been attracted to select the routes they followed.

The more intensive users of the Forests of Montana in 1923 totaled some 150,000. Of these, 94,000 comprise people who entered the National Forests for one day's outing which might include merely picnicking, or in addition to that, hunting, fishing, or berry picking. These are all local people who leave their homes for a pleasant day in the mountains. Thirty-two thousand, mostly local residents, entered the Forests for peroids of longer than a day and established their own camps for lengths of time varying from over-night to a number of weeks or months To either of these wo classes the National Forests are open at all times and everywhere without restriction whatsoever except the urge and requirement that care be exercised in the matter of forest fires and in the matter of the pollution of streams, destruction by vandalism of scenic spots, and the marring of camp grounds; in some restricted areas of particularly high fire hazard camp-fire licenses must be obtained from local Forest officers before camp fires can be built.

Some 18,000 people in Montana spent vacations of from a week to several weeks at the many hotels and resorts which have been established for their accommodation. These resorts vary from those which accommodate under the roughest kind of hospitality people who are interested *only in hunting* or fishing or mountain hiking, people who may merely *wish to come* and rest and feast their eyes on the ever-changing scenery visible from the hotel and resort sites, to the more pretentious hostelries which add to these pleasures some of the forms of recreation that may be found in other vacation localities, such as swimming and boating, tennis, and other games.

Relatively one of the more rapidly-growing forms of use of the National Forests is by people who establish, under Forest Service permit, summer homes in the Forest. These vary from a more or less pretentious summer lodge of some wealthy eastern man to very inexpensive and unpretentious little gray homes which are within the financial reach of the ordinary human. These are privileged by the Forest Service at nominal annual rates varying slightly with degrees of accessibility and desirability of the sites selected. In the year 1923 there were about 350 of such summer homes, an increase of some 40 over the year before, which housed over 3,000 resident owners and their guests. These summer homes are occupied from a few weeks to all summer. At many places such as Seeley Lake, on the Missoula National Forest, not far

Alpine Lakes in the Flathead National Forest from the city of Missoula, and at points around the larger towns such as Butte and Great Falls, the summer homes are established so that a man's family is easily reached by him over the week ends when he drops his bread-winning activities for a Sunday visit.

While the automobile is still the principal mode of transportation and always will be, many people avail themselves of the National Forest recreational utilities through other means. During 1923, in Montana, 8,000 journeyed to the Forests by means of stage lines, boat lines, and railroad. Another 10,000 traveled by horse, wagon, or by boat, and 11,000 acquired the extreme pleasure of the open road or the trailless wilderness by resorting to the old method of transportation, "Shank's Mare." The number of hikers is annually on a pronounced increase.

There were within the National Forests of Montana at the end of the year 1923 some 80 regularly established and organized public camp grounds. Many others are being added and improved as rapidly as public, institutional, or private funds are available. There are also about 80 resorts and hotels equipped to take care of the traveling public. These are also rapidly increasing in number. In conjunction with many of these resorts, saddle and pack horses are available for "roughing it" trips in the back country.

The Forest highways in the main follow along the larger rivers and stream courses where ideal camp spots not regularly developed but under natural surroundings can be found. Here one can stop alone or with his immediate family and companions and make his camp for a night or a day or a week among the tall trees and in the woodland stillness. He can take his rod and flies and, provided he has a State license, can lure the wily trout to his frying pan to appease his ravenous outdoor hunger. These camp spots are used very heavily although some people prefer to stop at points which are provided with the usual camp conveniences such as fireplaces and water development, and where they meet with and mingle with some of their fellow vacantionists. In some localities, because of Forest fire danger, it is necessary, absolutely, to confine camping to such developed camp sites. It is regrettable, but human carelessness with fire in the past has caused the loss not only of untold millions of board feet of timber necessary for the economic development and future of the country or forage grasses badly needed by growing cattle and sheep, but also even of the beauties of the theretofore available camp spots themselves. During the year 1923, there were started by recreationists in the Forests of Montana 87 fires, which, fortunately, cost the commonwealth not more than $3,000 for fire fighting and in the form of damage to timber. The figures for damage and costs were unusually low because the season was abnormally wet, more or less frequent rains during the summer having dispelled the ordinary dangerously dry fire conditions of the summer months. Ordinarily this number of fires causes a great deal more damage. For example, in 1921, some 300 fires cost some $5,000 to fight alone and caused a damage estimated at about $5,000, and in the summer of 1919, a very dry season, the figures *were vastly* greater.

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Into Little Known Wonderlands.

from the city of Missoula, and at points around the larger towns such as Butte and Great Falls, the summer homes are established so that a man's family is easily reached by him over the week ends when he drops his bread-winning activities for a Sunday visit.

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Into Little Known Wonderlands.

SQUEAKS—

YOUR DUTY

We know that fire prevention is more effective than fire suppression, to say nothing of the lesser cost. A word here and there to forest users and permittees will do more than a hundred shovels and mattocks toward keeping the forests green. Whether we are temporary employees or permanent forest officers, we are bound to meet forest users almost daily and a kindly word may save us thousand's of dollars' worth of timber. The average man who goes into the woods for a week's vacation is not malicious but he will be careless at times. He fails to realize the amount of destructive energy of the carelessly dropped match. Legal proceedings and "Damn you, be careful with fire!" signs will antagonize him, but if we meet him on the trail or in camp we can tactfully call to his mind the danger of the glowing cigarette butt and the unextinguished campfire. Then there are logging camps to be visited, stock association meetings to be attended, and homestead claims to be examined. We can and must convince our permittees that we are doing out utmost to "keep fire out of the mountains and poverty out of the valleys." And last, but by no means least, let's not forget the little red schoolhouse. A short talk to the "kids" may do more good a few years from now than all the P. R. work we can get over to the grown-ups. If we can sell the forest idea to the receptive minds of the youngsters we will have an army of potential P. R. workers in a short time.

* * * * * *

JUST A THOUGHT

A college or a university is but a mimic world in which every student plays his self appointed part. That part may be restricted to a minor or even negligible influence on his own little group or it may expand to a dominating sphere in the whole life of his University. The choice is his. Will he idly drift, hour by hour, day by day, never flunking, never speeding, a name on a class roll not a personage, known to few and respected by none, futilely dreaming of the successes of tomorrow when tomorrow can bring no success because of a hundred inconsequental yesterdays? A Forester! Never. Forestry demands leadership, self-reliance, courage. Can a man miraculously acquire these attributes after years of passive drifting? Does the man who fights his way to class leadership, to a school or varsity team, to a dominant position in club or college activities, to campus recognition, fail when his life work is commenced?

The products of the forester are wood and water. The tools of the forester are men. Can you lead if you have always been led? If you *cannot assume* responsibility now, will you ever assume it Yours is not *a profession* of an office and clients coming to your door. You are a

From the EDITOR'S CHAIR

Forester. It is not yours to do the things yourself, but to direct others in their accomplishment. Your own effort would make but a pitiful showing in the need of the nation. How many acres can you plant in a day. How many miles of railroad can you build or how many cents can you reduce your logging costs? Not an acre, a mile or a cent, but under your capable direction a thousand acres or many miles or a profitable operation can well be had.

—T. C. S.

* * * * * *

SUMMER WORK

The one thing we all look forward to is the opening of the field season. Strange to say, salaries seem to have little influence on the choice of work, but the smell of growing things makes our feet itch for the trail. Some of us visualize another four months in the big Coast forests; some plan on sunny California; some can smell the sage in the Southwest and many of us long for the pine and fir of Montana's outdoors. We may swing a pick on a trail crew, check up on grazing work, scale logs or fight fire. Whichever it is, the type of work and the country we expect to work in generally decides our course. At any rate, in the Service the little blue-lined envelope is often all too small, but the satisfaction of rendering service to a worthy cause—of doing work we love, and of work well done—this can never come with paychecks. Fifty years from now a city's people may drink pure water because of a watershed we protected from erosion today, and when we have battled the fire demon for what seemed days without number, we can still smile—a hundred years from now some family may be able to build a home because of that reproduction we saved.

* * * * * *

And, talking about keeping the forests green, why not keep them clean? Gentlemanliness is measured by the same standards the world over, and we sometimes are led to believe that the average man from the woods is just a little more of a gentleman than the average man from the city. We have seen old-timers who, in blazing a new trail, merely chipped the bark in order not to injure the trees. The "ocean-to-ocean" highway is probably the best marked road in the world—just follow the tin cans. The Service regulations provide effective remedies for this evil, but it is largely up to the individual officer to see that they are complied with. Isn't it enlightening to find that in 1918 "J. B. H." hacked a chunk out of some fine old pine tree to carve his initials in the heartwood, or to stand beside a lacy water-fall and see a beautiful sign, proclaiming to us that "Wear Ever" sox are the best on earth? It's *pretty hard to improve on* the beauties of God's out-of-doors. Why try it?

FORESTRY EDUCATION IN MONTANA

By T. C. SPAULDING
Professor of Forestry, University of Montana.

Montana may aptly be termed the crown of the North American Continent. From its forested slopes waters flow northward into Hudson Bay and the Arctic Ocean, westward into the Pacific, eastward to the Gulf of Mexico and the Atlantic. The Saskatchewan, the Columbia, the Missouri—greater rivers than these are found in but few places in the world. Our 24,000 square miles of forest land may well be likened to an immense sponge, absorbing, holding and slowly dissipating those waters that, after serving our own people, pour their mighty volumes into three oceans.

Our irrigation, our water power, a cheap and continuous supply of lumber for the building of our homes and the large revenues we annually obtain from tourists, hunters and other summer visitors are directly dependent upon the maintenance and preservation of our forests. The lumber industry, devoted to the utilization of the mature stands, expends in the neighborhood of $4,000,000 annually as wages, and for supplies that largely consist of products from our own herds and farms. The wages are spent here. The yearly freight bill on our manufactured lumber and timber products is reported to be about $1,500,000. Over 100 carloads of logs now come into Missoula and Bonner every day. A goodly share of these revenues go to make for prosperity among our railroad people and from them it radiates to the communities and to the farms. Forest and mine products move continuously. Farm and ranch products are seasonal. Were it not for lumber movements the periods of stagnation and depression would be far more severe among railroad men than they are at present.

Montana's prosperity is dependent upon the permanence of her agricultural, forest and mining industries, particularly the first two. To develop and maintain the agricultural industry in this state requires careful study, detailed investigation and the will to overcome the difficulties imposed by a new land where the rules and precepts of more favored regions may or may not apply. The same statement applies to the management and preservation of our forest areas. Our dry climate retards our tree growth. The forests may assist in the irrigation of a million acres but they themselves cannot be irrigated. It takes the forester twice the length of time to produce a merchantable tree here than it does in more favorable regions. We must have the forest because the more favored regions cannot furnish us the indirect benefits derived from our woodland nor are the people of Montana in a mood to pay huge freight bills on products we can produce in as good quality, if not in as short a length of time, here at home.

To assure its people an ample supply of wood, water and the accompanying benefits, Montana has wisely provided for a comprehensive system of forestry training, education and investigation to go hand in hand with the actual utilization and administration of its 15,000,000 acres of timber producing lands, particularly the 3,000,000 acres of private and state owned forest property. That this educational and investigative program might best meet the present and future demands of the people of the state the School of Forestry at the State University was created by legislative enactment.

The creation of a School of Forestry alone was not sufficient. It was yet to determine just how, besides giving collegiate training in forestry, it might be of maximum service to all those directly or indirectly dependent upon the state's forested land. After careful analysis of conditions, the following lines of service have been adopted:

General program, School of Forestry, State University.

1. Cooperation, investigation and general assistance to the people of the state, and the State Forestry Department.
2. Collegiate training in Forestry leading to a degree in Forestry or Forest Engineering.
3. A two-year sub-collegiate course in Forestry for disabled ex-service men.
4. A short course in Forestry.
5. Extension work.

To fulfill this program the University has erected one of the finest Forestry buildings in the United States. It has laboratory, classroom and library space ample for all present and immediate future demands. Space has been provided here for the State Forester and his staff that all the state's forest activities may be together for economy, cooperation and mutual benefit. Missoula's advantages as a training ground for foresters are unsurpassed anywhere. It is in the heart of the state's timber wealth, over half of its lumber production is within thirty minutes' ride from the Forestry Building. It is the headquarters of the northern district of the Federal Forest Service with a numerous corps of highly competent foresters and it is in the center of activity of federal, state and private forests industry of this region. That these advantages are recognized is apparent since the enrollment in technical collegiate work is exceeded only by one forest school in the United States while the regular attendance at the Short Course is the largest in the country. Much of this success may also be attributed to the cooperation of th United States Forest Service officials, the lumber industry, and in the last few years, the State Forester.

Success, and with success a redemption of the responsibility of the school to the people of the state, is not measured by what has been done, but in the ability of the faculty to anticipate the demands of the future and to be ready to meet those demands as they arise.

An analysis of the present and proposed lines of education and cooperation follows:

1. **Cooperation and Investigation.**

   Past.

   Assistance in estimates and appraisals cooperation in the

establishment of forest protective work. Lecture and educational work with and before allied organizations.

Proposed.

Silvicultural and management studies looking towards the determination of the financial possibilities in private forest management. The solution of the woodlot and windbreak problem for the benefit of the farmers of the prairie regions of the state.

Adaptability studies of exotic trees for both park, shade and field planting.

The utilization of by-products.

2. **Collegiate training in Forestry.**

This training must be divided into two lines:

   a. General Forestry training—i. e., in the growth and management of the timber crop up to the time of harvest.

   b. Forest Engineering—i. e., in the harvesting and marketing of the forest.

Both lines of specialization have been offered in the past and will continue to be given. The field is so broad and so technical that competent training in both cannot be obtained in a four-year University course. Future developments in the industry will require additional lines of specialization. These can be added with but slight expansion of the present staff and equipment when the demand arrives.

3. **Sub-collegiate vocational training.**

The nation wide demand for assistance in the training and rehabilitation of disabled veterans was quickly met by the establishment of a two-year course in Forestry to meet the needs of those who, through lack of high school training, were unable to undertake collegiate studies. This course fitted the ex-service man for field positions in Federal and State services and as scalers, etc., in the industry.

A temporary discontinuance of this course appears advisable at the end of 1923-24 school year. But few ex-service men are now demanding training. Montana has more than fulfilled her obligation to the nation and to the men. Admittance will be readily granted those who can meet the University entrance requirements. Those who cannot, will be allowed registration and training in the annual Short Course.

Eventually this two-year training course for field men in Forestry must be re-established. The rapidly decreasing timber supply of the State and the Nation will require a higher degree of training and skill among the field force than can be given in a three months' course. The management of a tract of growing timber is a highly technical undertaking, if rightly done. Those who put into operation the plans of the forester or forest engineer must be equipped to do so intelligently. Experience has shown that a two-year special course similar to the State's Sub-Vocational course is best suited to adequately train this class of employees.

4. **Short Course.**

The three months' Short Course given in Montana is the largest and most comprehensive of its kind in the country. Despite rigid entrance qualifications it draws students from all over the United States. It has now become necessary to limit the attendance solely to those who can show good reasons for their presence. This success can be attributed only to the quality and serviceability of the instruction given by the staff of the Forest School, the special lecturers from the Forest Service, and the various departments in the state organizations.

This course should be continued until necessity for more detailed instruction compels field officers to undertake a longer period of training. It can then be varied in subject matter that it may serve as a review course for both professional foresters and field employees.

5. **Extension work.**

High school and public school work. This has been limited in the past to miscellaneous lectures at vocational conferences, fire prevention campaigns and similar activities. This work must be supplemented by the preparation of data for high school source themes; outlines for high school curricula best adapted to meet the requirements of students expecting to undertake collegiate work in Forestry; the preparation of displays for fairs and similar purposes; compilation and publication of lecture material for women's clubs, civic organizations, etc., and the preparation of leaflets, etc., for grade schools.

An intensive educational campaign has been carried on during Fire Prevention weeks in 1922 and 1923. Selected men from the lumber industry, the State's Forest Department, the Federal Forest Service or the School of Forestry have visited practically every school in the western part of the state in an endeavor to spread the gospel of forest fire prevention and conservation of the timber resources. Supplemental work was done with all organized clubs and civic bodies. Every possible means is utilized to place the fire problem before the pepole and to secure their cooperation in saving Montana's wealth for Montana's people.

FORESTRY CLUB

The Forestry Club, including most of the students and faculty of the school, is without a doubt the biggest and livest organization on the campus.

With the completion of the "New Shack," the club has been fortunate in securing a club room which is second to none in the University. The big library is used as a get-together place for forestry students, and all regular meetings are held here. A large fireplace, game heads and magazines galore, as well as the spirit of informality and fraternalism which always prevail, help to make it an ideal club room. Albums, pictures and additional trophies of the hunt are being secured and will be added to the present decorations.

The Montana Forestry Club is affiliated with the International Association of Forestry Clubs, an organization which meets annually to discuss Forestry Club affairs and problems. Last year the convention was held in Missoula, and Montana acted as president club and host. The 1924 meeting was held at Ames, Iowa, and Montana was represented by Les Colville, who reported a very successful meeting.

Membership in the club is limited to students of forestry who sig-

I.A.F.C. Convention — "Nine-Mile" Camps

FOREST CLUB ACTIVITIES —

Foresters' Campfire Hike, at Spring Gulch.

"Ring"
A true forester

Editing the 1926 Forestry Kaimin.

Montana Forest Club Float

At the Clubs new fireplace

nify their desire of joining by signing the rolls and constitution, and submitting to the initiation which is held each year at Spring Camp. The purpose of the Club, as stated in the preamble, is to stimulate interest in forestry matters and to promote good fellowship among the students.

Meetings are held twice a month in the new shack—Pinchot Hall—and the program is laid out with a view to securing the objects of the organization. After the business meeting an informal talk is given by an expert on some topic of forestry of kindred matter. The Club has been fortunate in the class of lecturers it has been able to secure for meetings. The U. S. Forestry Service maintains a large corps of scientific and administrative experts at the District Office in Missoula, and these men are always willing to talk on their individual specialties.

Then follows the social part of the program. The club has purchased a piano and several of the members are experts on this and other musical contrivances. Wrestling and boxing matches, movies, songs by the quartette, with an occasional number by Fay or Jerry, and other forms of entertainment are provided. The meeting concludes with hot dogs, doughnuts and coffee, served by Paul Bunyan cooks.

The activities staged by the Club during the school year are many and varied. Soon after the beginning of school a picnic is held up one of the nearby canyons so as to get the new members and old-timers acquainted with one another. The last picnic was held in Marshall Gulch in October and a good time was enjoyed by all. The moon was just in the right state and Les Colville's date-making agency did a flourishing business for the new members. Smaller hikes and an occasional dances help to keep the ball rolling throughout the year.

A large float, depicting a forested mountain and lookout tower, was entered in the University May Day parade.

A banquet is given by the Club late in May, just before the end of school, as a final gettogether and as a farewell to the graduating class. At this banquet a number of professional foresters who have given lectures at the school are usually guests.

Speeches and songs enliven the meal until finally "College Chums" is sung and the Forest Club officially ceases to function until the following fall.

The Club's officers are usually elected at Spring Camp. The present officers are: Ralph Fields, President; L. W. Brown, Vice-President; Howard Nickolaus, Secretary; Leroy Merryfield, Treasurer.

THE FORESTERS' ANNUAL BALL

By SAM F. HARRIS

Ever since the establishment of the Forestry School on the campus, the Forester's Annual Ball has been the crowning event of the social season. Each year it has been bigger and better. The 1924 ball was no exception to this rule, only inasmuch that it surpassed the most vivid imaginations of those who have participated in like affairs of the past.

The committee was fortunate in securing the new gymnasium at the

University for the event. This gave them an opportunity to stage the greatest ball known and entertain the largest crowd ever assembled at the University or in Missoula for a like purpose, there being some seven hundred people in attendance. The committee was highly commended by Chancellor Brannon, President Clapp of the University, state forest officers, District Forester Morrell and many others from the district office.

The Chancellor expressed his gratification at being able to attend what he classed as the greatest social activity of this nature that he had ever participated in. He emphasized the importance of the ball as a means of solidifying the student body, of promoting good fellowship, of bringing the faculty and the student body together on a democratic footing, of giving each and everyone the opportunity to toss aside his "soup-and-fish" and social stiffness and don the garb and old-time happy-go-lucky attitude of the true Westerner—to really and truly lose himself among the joyous dancers.

* * * * * *

As one crosses the threshold, he stops short in amazement and wonders what hallucination has transported him into some fairy canyon. He blinks at the harvest moon slyly peering at him through the dark limbs of a pine, as he sniffs the pungent odor of cedar and fir. The moon, sinking in the gap, ilumes the western slope, heavily timbered, and the eastern slope, which has been ravaged by the demon fire. Nature had walled in the peaceful little oasis with living green timber, which seemed to watch in protective and benevolent silence the brilliant and picturesque forms of the dancers.

A soft rosy glow from an open doorway extended an irresistible invitation to tarry a while in the Ranger's Dream of Heaven. Numerous couples were beguiled into lounging luxuriously among the soft cushions in the deep armchairs, while the strains of a dreamy waltz or a joyous fox trot strove to lure them away from the restful spell of soft lights on green boughs.

Just another door away a bright glaring light guided one's steps to where could be heard the clink of glasses and bottles, the slap of cards, the shuffle of feet as the bartenders attempted to quench the thirst of eager dancers, and above all, the insistent voice of the cryer at the roulette wheel, "Round and round the little ball goes. Where she stops nobody knows." Just one peep through the open doorway and one is lost. A thirst that one never knew existed springs into being with just one glance at rows of bottles bearing intriguing labels. Couples are shuffling through the sawdust for just another drink, while the weary bartender leans his monstrous frame against the bar, mops his streaming brow and tells his assistants to "give 'em what they want." After one has quenched his thirst, lost all his Paul Bunyan money at the roulette wheel and card tables, and has started to escape, he casts one more lingering look at the vivid pictures adorning the walls and the old-time bar and fixtures, which carry him back to other days which are gone, *but not forgotten.*

The strains of music attract one's attention to a lookout cabin in the center of the ballroom, or more properly speaking, of the miniature canyon. The be-whiskered musicians, smoking their old corncob pipes, clothed in typical ranger garb, industriously sawing violins and blowing trumpets, grant encore after encore demanded by the applauding dancers. If Paul Bunyan could have viewed the varieties of rangers, lumber-jacks, trappers, Indian maids and pioneers, he would have rubbed his eyes in amazement.

The unoccupied chairs testified that at a successful dance wallflowers fail to bloom.

The dancers could scarce tear themselves away from the bewitching waltzes and fox trots long enough to skip over to the Forestry Library for a midnight lunch, but when once there, they showed no inclination to leave their nut sandwiches and coffee.

The morning after the ball found the office of the Dean of Forestry deluged with congratulations on the stupendous success of the affair. The Rangers, or short course students, who had heard so many fairy stories of the ball, admitted that fairy tales do sometimes come true. Regular students and faculty members who have attended many like affairs in the past could not find words to express their thanks to the committee, which had so successfully handled the affairs. The 1924 ball has set a higher standard for like events in the future. The ball is over, but the memories will live forever.

"Into the Din and Glare"—Lounge-Lizard Bar.

NINE-MILE TRIP

By MARVIN RILEY

Approximately one hundred and twenty-five students of the Forest School of the University of Montana, together with about ten members of the faculty, Anaconda Copper Mining Company officials, photographers, etc., took a trip to the Anaconda Copper Mining Company's logging operation at the Nine-Mile camp, as one of the features of the I. A. F. C. convention, which was held here in March, 1923.

At 7 a. m. on the morning of March 10, the party gathered at the Chicago, Milwaukee and St. Paul station, where the log train, with a couple of passenger cars attached, was to take us to the camp.

Before we ever left Missoula, the first real excitement of the day occurred. One of the University profs appeared on the scene, proudly wearing a white collar and a necktie. It might seem only proper to wear this attire, but the Forestry student of the West has no desire to hide his identity. After a short but snappy struggle the collar and tie disappeared.

Judging from the way the gang boarded the train, one would think that every man was taking Improvement Construction and was practicing climbing phone poles, and the caboose was the favorite spot. After a time we all were placed and on our way.

That trip up was agonizing to say the least. Banjoes, ukeleles and mandolins were in perfect discord and some alleged singing took place until the performers were forcibly quieted.

From the time when we arrived at the headquarters camp until the dinner gong sounded, all busied themselves in looking the place over. Some of the younger men had apparently never been in a lumber camp before and they sure got an eyeful. The entire camp was open to us, and in true forester fashion, we didn't lose the opportunity. While at headquarters camp a group picture was taken and that photographer gave a great display of patience before the agony was over.

The next thing in order was that part of the trip which will always remain with us as the most vivid impression of the day. The flunky didn't have time to sound the dinner gong before he was actually mobbed. Such a feed had never been seen before and probably never will be again. It is worth a long and tedious journey to eat a meal like we had at headquarters camp that day. The only person who failed to thoroughly enjoy that meal was the aforementioned prof. The mathematical formula of chance failed to work, but a cook with a butcher knife in his hand did work, and the hat was taken off.

No sooner had the last man left the mess house than the real business of the day began. Seats had been arranged on log cars and we were taken to Camp No. 3. What a ride! If the concern that makes that particular "Shay" engine could see where it goes, they would advertise them as tanks for use in the next war. There were only about five bronco busters on the trip and these were the only ones who could stay on the engine. And that so-called track! Now we know where the expression originated that it would "break a snake's back to follow that track." An old Irishman who is teamster on a chute there and who was on the first drive that was ever put into Nine-Mile creek, says that he was told that the track was made from Paul Bunyan's corkscrew, but he doesn't believe that because the track is too rough and crooked.

Despite all handicaps imaginable, the "Shay" finally landed us on the operation at Camp No. 3. Here we had an opportunity to see three kinds of chute logging in one chute. The logs were started by gravity, then horse power was used. then more gravity on a 30% slope, and then a donkey engine and cable finished the job of bringing the logs in a distance of over a mile. As soon as the logs arrived at the yard, the jammer picked them up and accurately placed them on the waiting cars.

Not to be out-done by any lumber-jack, some of the fellows proceeded to ride the logs down the chute, with various degrees of success. It was at this time also that one of the students succeeded in persuading the prof to give away the last cigar of his favorite brand.

After having taken in all of the sights of Camp 3 the visitors departed for Camp 4 where more skidding, chuting and loading was being done. By this time the March wind was beginning to blow and more time was spent in trying to keep warm than in looking around. The majority had seen more than they had expected or had ever seen before and all were sure that they had had their money's worth.

Soon the whistle blew for the start home and everyone was ready. Spirits were not dimmed, however, and as many remarks were cast at the entertainment offered as had been on the morning trip.

Everyone felt well repaid for the trip and surely appreciated the efforts of the Anaconda Copper Mining Company, through their representatives, Mr. Haines and the camp foreman, Mr. McKenzie. Afterward, in talking over the trip, the most common remark heard was, "Man, what a feed that was!"

ANNUAL INDOOR MEET

Some three hundred boosters of the Forestry game met in the new gymnasium Wednesday night, March 12, to witness the most spectacular contest ever staged between the Rangers (short-course students) and the Regulars, or regular students in Forestry. This was the tenth annual meet between these two bodies. A great deal of credit is due Professor Clark and the committee for the success of the meet. The various contests on the program were entered into with zest and enthusiasm, especially by the Rangers, who were determined to win. The Rangers were highly gratified with the final score—17½ to 40½ in their favor, being the first time the Regulars have ever been defeated by the Rangers.

Milton Ritter, Regular, won first place in the rope climbing contest by ascending the rope like a red squirrel going up a hickory tree. Cottam, Ranger, was a close second. The Rangers displayed a great deal of science in the Tug-of-War. and with a bulldog grip on the hemp they steadily pulled the regulars over the line.

This even was followed by a basket ball game which will be long remembered by the spectators. At times the players on both sides displayed real gridiron tactics. From time to time could be heard the referee's shrill whistle as he waited for the players to disengage themselves from a "squirming, struggling, kicking mass." For all their rough tactics a great deal of science was exhibited, such as quadruple dribbling, first with the left hand, then with the head, followed with the right hand and finally with both hands. Spencer went around the Regulars' end repeatedly for a touchdown, only to be foiled at the last moment. The final score gave the Regulars the game, 24 to 6. The outstanding features of the game were the sportsmanlike attitude of the players, the hilarious enthusiasm of the spectators and Dr. Schreiber's shrill whistle, which could not be subdued by the Doctor's cracker diet.

Rutherford, Ranger, showed great ability to exist on a dry diet in case of an emergency, by eating ten crackers in two minutes and emitting a shrill whistle at the finish.

Whiting won the chopping contest for the Rangers by wading through a 14-inch log in one minutes and 18 seconds. The Regulars, after watching this exhibition of axmanship, pulled in their "longhorns" and conceded the chopping honors to the "Shorts."

Fields and Crowell represented the Regulars on the two-man saw. They showed great sportsmanship and courage but were short on practical experience in manipulating the thin ribbon-like piece of steel. They could not believe the referee when told they had performed the miracle in 34 seconds. Whiting and Flodberg then took the saw for the Rangers. The piston on a high-speed engine had nothing on them: the way that saw flew back and forth across that log severed it in 13 seconds.

The Regulars, represented by Post and Crocker, won the packing contest which amounted to an exhibition performance, the Regulars declining to compete after observing the speed and accuracy of the Rangers.

Mechling, at 156 pounds for the Regulars, and Feight, 175 pounds for the Rangers, wrestled two six-minute rounds to a draw. Mechling, though a lighter man, had conditioned himself for the M tournament, while Feight entered the bout without a workout.

The second wrestling bout, between Cottam, 149½-pound Ranger, and Stocking, 149½-pound Regular, was snappy from the start, Cottam winning in ten seconds.

Excellent sportsmanship was displayed by both sides. The Rangers were on their toes from the start, were well organized and ready to jump into each event as it came up, while the Regulars were slow at times, allowing one or two events to go by default. As the contestants on both sides mingled on the floor, a striking exhibition of good fellowship was apparent.

At the close *of the meet*, eats were served in the Forestry Library by *the Forestry Club.*

MONTANA DRUIDS

The need for a society of forestry upper-classmen has been felt for a long time. An organization of this kind would promote closer relationship between the members of the Forest School and its Alumni, and could assist deserving members in the profession to find their respective places. It could also foster the Forestry Club, help perfect a united and sincere body of foresters, and would act as an incentive for underclassmen.

With these objects in mind, a group of juniors and seniors convened early in February and decided upon the most practicable course of organizing such a group. It was finally agreed upon that a student, in order to be eligible, must be regularly enrolled in the Forest School, must have junior standing, with a C grade in at least 95 credit hours, and must have a sincere interest in the profession. He must also be an active member of the Forestry Club and must have engaged in extracurricular activities in the University. Forest School faculty members are also eligible, and a provision is made for Alumni and honorary membership. It was decided to name the society the "Montana Duids," in honor of the ancient Tree Worshippers, or Druids, of the British Isles, and a shield bearing an M and the leaf of the white oak was chosen as the emblem.

VOCATIONAL TRAINING

By R. H. CANFIELD

The true value of a school is measured in terms of service to humanity. The faculty is the heart of the school. On it, in no small measure, falls the responsibility for the degree of service rendered.

The Montana Forestry School is extremely fortunate in the possession of a faculty of which each member has added to his technical training the knowledge of forestry and of men that is gained only through practical experience in the field.

To this practical knowledge and the leadership of these men the characteristic good fellowship and fair-mindedness, which is dominant in the class-room or club, is chiefly due.

The readiness to meet the problems of life is another dominant characteristic of the school. This fact was demonstrated by the attitude of the faculty and the students toward the Veterans of the World War. Montana was among the first to open her doors wide to the Vocational men.

Entrance requirements were waived and for a time an opportunity given those who fell short of the requirements to make up the required subjects. Class-rooms were over-crowded, instructors over-worked, but no man faltered or failed. The reclamation project, involving the rebuilding of broken and discouraged humanity, was under way. Faith in men had to be built into a mass of wreckage that had little or no vestigae of faith left. Interest in life and living had to be revived. A way must be provided by which these men might give again and thereby add to the gift to humanity which had deprived them of their strength and health.

The success of this project is assured. The morale and courage, which in the old days knew no defeat, is again in evidence.

One hundred and thirty-seven Vocational men have enrolled in the School of Forestry. Eighty of these were transferred to other lines of training or returned to the hospitals because their disabilities were such as to prevent their entering the field of forestry.

As evidence proving the worth of this project there is a list of twenty-eight men that have been rehabilitated in forestry. Twenty-three of these are practicing forestry either in the United States Forest Service or in the employ of private concerns.

In the preceding quarter, eleven of the twenty-nine men in school made the honor roll.

The above figures not only prove that the men have taken advantage of their opportunity but it also shows that the school is making a record to be proud of.

SPRING CAMP

The 1924 Spring Camp will be held at the Biological Station at Flathead Lake, May 10 to 18. The camp is part of the regular forestry work for the year and each student is required to attend.

Due to the location at Yellow Bay, directly at the foot of the mighty Mission Range, the camp offers excellent opportunities to put into actual practice the things learned in the class-room. Classes will be held in surveying, mensuration, silviculture, forest management, grazing management, ecology, and other forestry courses. Trips will be taken to the mill at Somers, to the state fish hatchery, and to near-by logging operations. The "Helena," a 120-foot steamer, has been chartered for the week and will be used to transport the students and equipment from Polson to the camp and to points, such as Somers and Wild Horse Island, where classes are held.

The social aspect has not been neglected, however, and the entertainment committee promises to keep things humming at all times. Trips aboard the "Helena" will enable the students to visit places of interest about the lake, and plenty of row-boats will be on hand for races and for fishing purposes. Many aspiring Ike Waltons were ready to disprove Chief Myers' claim that he caught the largest bull-trout in the lake in 1922. The Chief also expected to be there to gather further scientific facts about the differences between "Dolly Vardens" and "bull-trout." These pet ambitions have been shattered, however, by the game laws, which do not permit fishing until May 28. Professor Spaulding has issued his annual challenge to all horseshoe tossers, and some of the lumberjacks from the logging classes have signified their intentions to take on all comers in the log-rolling contests in the Bay. Occasional

mail trips to Polson will break the monotony of camp life for those young Romeos who have fallen victims to the wiles of the fair co-eds on the campus. Lack of mail service proved disastrous in other years and caused several love-lorn foresters to hike twenty miles in order to catch an early train back to Missoula.

The camp offers a week's intensive practice, besides providing clean, wholesome fun for the men, and will be of great benefit to all, especially to the freshmen who are leaving for the field for summer work in a few weeks.

THE NEW NURSERY

By HAROLD HICKS

After many years of want and desire by the department of silviculture, work has begun on a nursery, which should fulfill all expectations and requirements for the School of Forestry.

The plot, which covers about three city blocks, equivalent to five acres, lies just south of the Gymnasium and at the foot of Mt. Sentinel. This site was chosen for three reasons: (1) with Mt. Sentinel on the east, rising 2000 feet, protection will be given the young growth from the early morning sun, thus reducing damage from frost and sun-scald to a minimum; (2) sub-irrigation from the mountain slope will be of benefit, and (3) the soil is deeper and more fertile at the foot of the mountain. Probably the greatest disadvantage to this location will be danger from wind, which may blow the soil from the seed beds.

Seed will be started in the beds, and after one or two years the seedlings will be transplanted in rows. After two years in the transplant rows, they will be ready for final planting in the field.

It is the present plan to keep supplied with seedlings the new Forest Reserve, which was recently placed in charge of the Forest School. This reserve is the old military reservation, about four miles south of school, in Pattee Canyon. Reforestation experiments will also be tried on the lower east slope of Mt. Sentinel. The nursery will be used as a source of tree stock to the people of the state, at cost; and also for street and park use throughout the state. Native conifers will be used for reforestation, while hardwoods will be grown for aesthetic purposes. It is also planned to experiment on a small scale with a large number of species, probably 200 varieties. Particular attention will be given to trees suitable for "dry land" ranch planting.

The nursery should be of interest as well as of great practical value in trying out seed from various parts of the country. The conifer seeds were gathered throughout the Northwest and the hardwoods in the eastern part of the U. S. Some of the local seed was collected by students from the school, while some was purchased from the U. S. Forest Service.

This project will not only be a great addition to the School of Forestry, but will soon be serving the people of the state, who have long been in need of a reliable source for tree seedlings.

A Corner of the Forester's Laboratory.

THE FORESTER'S LABORATORY

We have heard of many and varied forms of laboratories. The chemist, the botanist, the geologist, the journalist—all have their own forms of laboratories. Once, even, we heard a lawyer refer to a "law laboratory."

Every day, year in and year out, the forester's duty takes him into his workshop—his laboratory. Stretching from coast to coast and from border to border, containing all the chemist's chemicals, the botanist's genera, and the geologist's rocks, and those organisms and inert things which are sacred to the forester's profession, his laboratory is the largest, the most complete, the most harmonious and the most beautiful on earth.

Giant pines and firs in rows like test tubes, lakes, with emerald-colored, icy water, in place of retorts, glaciers that have endured through countless ages, towering crags, containing all the geologist's rocks, and plains and meadows with a wonderful abundance of plant life—these constitute the forester's materials. His tools are men, tanned and weather-beaten—empire builders. His products? Homes for a million families, lumber for commerce, ships, fields made green by flowing water, electric power that lights our streets and homes and does the Nation's work, fat cattle and countless bands of sheep, lakes to admire, green trees to rest under—these are his products. They exist because of his labor and effort. Days in the open, nights on the trail, fighting fire, riding, climbing, packing—his work. The satisfaction which comes only from service—his compensation.

Made by Providence, guarded by men wearing the Pinetree Shield, the forester's laboratory furnishes the materials and the products from which other laboratories are made.

—H. E. S.

SUMMER WORK

There are two periods during the scholatic year when much medicine is made in the Forestry Club-room, the various men's dorms, and wherever Foresters are prone to congregate after classes. The freshmen students, uninitiated as yet in the mysteries of summer work, usually listen in on these discussions and go away, somewhat apprehensive.

Along in May, when the campus maples are turning green, and hikers begin to populate the sides of Mount Sentinel, every forester feels the urge to go out into the Big Sticks again. At this time of year the talk runs largely to questions about new forests, different lines of work, salaries, prospects of the coming fire season, and possible promotion from last summer's positions. There is usually great activity in letter writing by those who wish to secure employment in distant districts or with private concerns.

Then, in the fall, when the "old-timers" reassemble and become acquainted with the frosh, the talk runs to fires, trails, phone lines, grazing and other work accomplished during the field season just past. Lurid tales that put Diamond Dick in a back seat, are often heard. Exaggeration is never barred from a Forester's conversation and, day by day, the packs carried become larger, the horses pitch a little harder, telephone poles become thinner and taller and shots made during the summer become more difficult. Each man maintains that the particular forest on which he "performed" during the summer is the best forest in the country, and relative claims are often based on such advantages as the number of rattlesnakes, square miles of sagebrush, or the number of sheep grazed.

Administrative work is always popular with Montana men, and each summer they drift to the four points of the compass, working for four months in positions varying from lookouts and smoke-chasers to district rangers.

The time was, and not so very long ago at that, when college men did not receive the recognition that was due them. That was in the days when the Service was young and logging companies did not realize the necessity for trained logging engineers and technical foresters. The coming timber famine was only a vague shadow and scientific forestry, or rather the correlation of practical and scientific forestry, seemed a long way off.

Then, too, the timber shortage was more apparent in the east than in the west, with the result that the eastern states took the lead in placing forestry courses in the curricula of the schools. Men going into the Federal Service were unacquainted with western conditions, and they were long on dendrology and short on experience.

Along in 1910 the Forest Service provided a short course to be given at the Montana State University at Missoula, for the training of rangers and field men. This course has been continued since that time and each *winter* many "short horns" from all parts of the west, and some from *the east*, are introduced into the intricacies of botany, mapping and *D. M. D's*. The regular course has been steadily built up and added to until it attained its present high standard. The two-year sub-collegiate course was a result of the World War and was initiated to train disabled war veterans for various forestry positions.

The Montana Forest School is fortunate in that it is situated in the heart of the western mountain country where the largest forests are located and where forestry and logging will be concentrated for a long time to come. Classes can be and are held in the field under the same conditions which exist in actual forestry practice. Trips to logging operations, to the Forest Service Nursery at Haugan, to sheep camps, and especially to Flathead Lake for the annual Spring Camp provide the link between theoretical forestry in the class-room and practical forestry in the field. These trips are of great help to the newer students and serve as an introduction to western conditions. Thus, after a man has been at school for three quarters, he has been in the field sufficiently to provide him with a knowledge of conditions as they exist in the field.

The officers of District 1, aside from the instruction they give in the school during the year, take a personal interest in the students and assist in placing them in positions during vacations, where they will secure valuable experience. The freshmen are usually appointed as forest guards or "smoke-chasers," where they have an opportunity to study fire protection, trail building, phone construction, forest improvements and similar phases of work. A careful record is made of their work and they are assigned the following season to work best suited to their talents. This work, aside from the training, is highly profitable and makes it possible for a student to earn the greater part of his expenses through college after the first year.

Summer work plays a very important role in the Civil Service examinations for forest ranger and for the more technical forestry positions. Without having had several seasons' experience in the field it would be very hard, indeed, to pass one of these tests, and if it were possible to pass without much practical experience the appointee would be very seriously handicapped through lack of knowledge about conditions as they exist on the ground.

The returns from the Junior Forester and Junior Range Examiner (formerly Forest Assistant and Grazing Assistant) examinations demonstrated the fact that Montana's Forest School seniors are well qualified to step into technical and scientific positions in forestry and that the system of placing all students with the Service or with private concerns is not only practical but actually indispensible. Five men, of the six who took these highly specialized exams, passed and are now in line for appointment in technical positions in the U. S. Forest Service. This high average testifies very well as to the brand and quality of Montana's forestry courses and the value of summer work in the foresters' workshop—the out-of-doors.

Felix Koziol ,Marvin Riley, Ralph Crowell and Oscar Beckstrom were the lucky ones in the Junior Forester exam, while Herbert Schwan came out on the high side of seventy in the grazing examination.

The following list is by no means complete. An attempt has been

made to present the information concerning positions held by last year's students, but this has been limited to the boys who are back in school this year. The upper-classmen, almost without exception, were out in the field, made good, and, as this magazine is going to press, are rolling up the tarp, packing the old duffle bag, and are getting ready to hit the trail again.

James DeJarnette, affectionally known as "Monk" to the men at the school, who, on April 16, 1924, passed over the last lonely trail that leads into the Valley beyond the Great Divide, worked on the Pend d'Oreille Forest in Idaho, as lookout. "Monk" was well liked in the Service as in school and was always more than willing to perform his share of any task that needed to be done.

Practically all the 1924 seniors were engaged in actual forestry practice in the field. They worked in all parts of the west and came back with a variety of tales, well told because of three years' former experience, that amazed the under-classmen.

L. W. Brown, otherwise known as "Doc," vacationed on the Cabinet National Forest in charge of a timber survey party. Most of his work was done under pioneer conditions, often beyond the reach of even a pack trail.

Carl "Step-and-aHalf" Beall received an appointment as forest ranger on the Tenderfoot Ranger District at Campsite, Montana, on the Jefferson Forest. His work was largely grazing.

Les Colville was with an A. C. M. Co. cruising party on Thompson River and the upper Blackfoot. Les' well-worn Jeffersons testified to his stories concerning the roughness of the country.

Ralph Crowell went back to sunny California and was employed as fire-guard on the Plumas National Forest. After the fire season he amused himself cruising in the big timber in that country.

Ralph Fields remained in Missoula and attended the summer school session. "King Tut" Burtness and Marvin Riley also whiled away the summer on the campus in the same manner.

"Bud" Lambert was stationed on the Frenchtown Ranger District, Lolo Forest, as lookout on Petty Mountain. "Bud" reports an easy fire season with only four small fires.

Charles (Czar) Nickolaus returned to his old haunts at Grangeville, Idaho, where he worked with a fire survey crew on the Nez Perce Forest. His brother, Howard, was stationed as a guard on the Selway National Forest, later doing trail construction work in the same locality.

Felix Koziol chose his location in the white pine country and was employed as an assistant ranger on the Moyie District, Pend d'Oreille Forest, in Idaho.

Bill Painter tried the Bigtree country in California and herded dudes on the Stanilaus Forest. His chief duties were those of fire-guard and lookout.

Herb Schwan went down into the Grand Canyon country in Utah, where he had charge of a ranger district on the La Sal Forest. His work

Summer Work

Bridge on the Flathead.

Packing on the Cabinet.

Packing salt on the La Sal National Forest.

Branding.

The Road's End.

consisted mainly of grazing and erosion control and some grazing studies work.

Allan Zamansky worked on an irrigation project in the Bitter Roots. He helped run lines and later tested the comparative usefulness of wood, concrete and earth flumes.

Juan Daproza was with the Forest Service, working in the vicinity of Seeley Lake, near Missoula, and later working on a surveying job.

Don Graham was doing entomological work in the western part of the state.

The Juniors showed the same spirit and took to the field with enthusiasm.

Harold Craven was employed by the Eastern Washington Timber Protective Association, an organization of private lumbering concerns, as a fire-guard, lookout and game warden.

John Cramer followed the grazing game with a reconnaissance crew on the Helena National Forest under the guidance of "Parson" Sandvig, one of last year's Seniors.

Vincente Caguioa, otherwise known as "Google," was employed as a ranger in the Philippine Forest Service, coming to the States in time to enter the Montana Forest School in the fall.

Jack Baggs was located at Gold Creek Ranger Station on the Missoula Forest as assistant ranger. Jack spent some time on trail and phone work but reports a quiet season with neither fires nor visitors at the station.

Harold Hicks was in that place where the summer men's Form 4b's finally go, having worked in the Treasury Department in Washington, D. C.

Earl Tennant had varied work on the Flathead Indian Reservation, his duties including fire patrol, work in the sawmill, and drafting.

Ray Tennant was with the Montana State Forester, scaling logs and keeping track of brush disposal. Toward the end of the season he was fire patrolman with the Blackfeet Forest Protective Association.

Charles Craig attended summer school at Missoula.

Stanley Lukens acted as head nurse to several million seedlings at the Forest Service Nursery at Haugan, Montana.

Tom Rowland learned technical and scientific forestry at the Priest River Experiment Station in Idaho, where he was employed during the summer.

Harold Petersen worked with the Forest Service on one of the forests in Northern Idaho.

The Sophomores were also scattered all over creation but we have tried to make the list as complete as possible.

Bill Dunstan was with a surveying outfit on the South Fork of the Flathead on the Flathead Forest.

Briggs Lund worked on the Plumas in California as patrolman and guard, and later was on phone construction. Briggs claimed the summer was monotonous except for the occasional visits of three Chinese Indian girls who lived in the neighborhood.

Ralph Minges was appointed and took a ranger district on the Leadville Forest in Colorado, later being transferred to the Nebraska National Forest.

Harold Russel started the season with trail work on the Cabinet, later being put on as guard and lookout on the same forest.

Palmer Paulson attended summer school.

Harry Van Winkle was employed at the Savenac Nursery at Haugan, Montana.

Most of the special students and vocational men attended summer school. The following men were students during the summer quarter: Bitney, Bliss, Bloom, Lee, McCoy, Moore, Myers, Schaub, Selberg, and Thompson.

Ray Bowers scaled logs for the Karren Lumber company at Patrick Creek, Kalispell, Montana.

Centerwall spent the summer mapping burnt-over areas and surveying on the Superior National Forest in Minnesota.

"Colonel" Roy Canfield remained in Missoula and gained some P. R. training at the Public Relations office on District 1. His improved brand of P. R. work seems to indicate a highly successful season.

Sam Harris worked on the Oregon National Forest near Portland. Sam's stories about the height of waterfalls, cost of trail construction, and the brand of scenery lead us to believe that it might be a desirable place to work.

Merryfield cruised timber and chased contours on the State Forest near Ross' Hole and on Cameron Creek.

"Captain" Walt Sutter was at the Priest River Experiment Station in Idaho, working on various silviculture study projects.

AN UNWRITTEN TOMBSTONE

This is the spot,
Where once there stood,
A stand of pine,
Both straight and good,
A stand that smiled,
Then laughed out loud,
And brightened the world,
Every time it bowed.

This is the spot,
Where once there stood,
A carelass man,
Camped out in the wood,
Who threw a match,
That burnt the pine,
That flooded the world,
With its bright sunshine.

—OTTO L. ANDERSON,
In American Forestry, October, 1922.

THE DOGIE

Riders circling 'round the bunch-ground,
Where the mesa grass-lands are,
Cattle bawling, dust-clouds floating—
Coyotes howling from afar.

Pinons flinging out their legions,
Purpling in the evening haze—
Spreading 'round the aspen ridges
Where little branding fires blaze.

Down where upland meets the desert
And the sage gives way to sand
Strays a little long-eared dogie,
Lost from out the round-up band.

Desert night is swiftly falling,
In the sky the evening star,
Riders slowly drifting camp-ward—
Coyotes howling from afar.

Fiendish laughs and howls and wails,
Shapes that dart from shade to shade,
Snarls and yelps about the carcass
As the coyotes serenade.

—H. E. SCHWAN.

SPRING

Come, roll up your sugans an' pack up some chuck,
For spring rains are fallin' on mountain an' plain.
Say—quit hibernatin'! It sure is good luck
To see brown earth a-steamin' after the rain.

Tighten your pack straps! There's gold over yonder—
An' if there isn't, there's work for to do;
We've wasted all winter. Don't sit there an' ponder—
See there's the trail! It's beckonin' you!
High rocky trails over sunshine kissed ranges—
Paths through the cedars where ferns brush your knees.
The blue of the sky which the thunder storm changes,
The song of the streams—and the wind in the trees!

JACK FROHLICHER.

HORSEBACK MEN

The horseback men were the freest men
From the days of the big ice pack,
When they first crawled out of their musty den
And followed a horse's track.
The caveman crouched in the dark and died
But his son found out that the world is wide
When he climbed on a horse's back.

Horseback men, O horseback men,
Bowlegged brave old crew!
Here's to your kin where the free stars spin—
Cowpuncher, Cossack and Bedouin,
Gaucho, Mongol and Sioux!

The bold Goth spurred into lazy Rome;
Great Genghis loped with his force;
Our Westerner fought for his wide new home
Bestriding a bronc, of course.
New land, new freedom, or just the deuce—
Whenever the spirit of man broke loose
He went and straddled a horse.

Horseback men, O horseback men,
The weak hide under their roofs,
But only the strong to your tribe belong
So history's mostly a horseback song,
And set to the thud of the hoofs.

But the sword bows down to the monkey-wrench
And the saddle fades from the scene,
For the warrior squats in a miry trench
Or charges by gasoline—
And grim Time, quitting his old horse jog,
Whirs us forward into the fog
On the wings of a swift machine.

Horseback men, O horseback men,
Your long day dims at last,
But your fame will climb to a myth sublime
From the horse tracks on the trail of Time
And the echo of hoofs from the past.

—BADGER CLARK, Sunset.

CHRISTMAS TREES

By M. W. THOMPSON
Assistant District Forester, District 2.

A census has recently been undertaken by the United States Forest Service to determine the number of Christmas trees retailed in Denver during the last holiday season. This shows that fifty-eight individuals or companies took out city licenses authorizing the retailing of Christmas trees. Questionaires have been sent to each of these agencies, the summary of which brings out that 47,400 trees were retailed in the city. In addition, 6,900 surplus trees were brought in which had to be discarded because of lack of demand. About 5,500 of the Christmas trees retailed in Denver were secured from the Pike National Forest, the balance secured from private lands.

According to the best information available, there are 292,492 people in Denver, and 62,000 houses and individual apartments here. The above information is interesting in this connection, for it indicates that a little over 75 per cent of the homes had Christmas trees. There is no higher use that can be made of trees than to gladden the hearts of children and grown people, too, for that matter, during the Yuletide period. While each year much publicity is given to the wanton destruction of trees for Christmas use, this utilization of trees offers a very important means of improving the forests. This applies particularly to the dense stands of young growth which are frequently in such a stagnated condition that little or no development can be expected without making improvement thinnings.

In the cutting done on the Pike National Forest this past season, an average of 353 trees were cut per acre. The removal of these trees materially improved the condition of the stand, for a fully stocked stand of thrifty trees was left to grow on to maturity. Markets in this region for trees of sappling or even pole size are limited, which is an unfortunate situation from the standpoint of Forestry, for in order to produce an ideal stand of timber, it is necessary to start with a dense stand of young trees and thin them frequently. The better trees are retained and freed of competition by the removal of a portion of the crop. This improvement cutting results in increased growth and the development of larger and better trees in a much shorter time than if the stand is left to grow along in its wild state.

BIG CREEK FIRE

Some fellow dropped a match. He didn't think
That this whole wooded hillside would be burned
Or that I'd labor here (God! I'd like a drink!)
Hell yes! A ranger's money's easy earned.

JACK FROHLICHER.

FACTORS IN THE GEOGRAPHIC DISTRIBUTION OF PLANTS

(Continued from Page 18)

California. From this center they subsequently moved northward and then eastward, some of them to the Rocky Mountains, but a considerable portion continued northward along the coast through British Columbia to Alaska. The principal elements in the Alaskan coastal forest are the Sitka spruce and coast hemlock, both propagated by small, wind-blown seeds. Fernow adduced an interesting explanation as to why these species failed to reach Kodiak Island and the Alaskan peninsula. In order for the seeds to be carried in this direction it is necessary for the winds to blow from the north and east from September to May when the spruce and hemlock release their seed, and it should be dry that the cones may open. Just the contrary of these conditions prevails, however, and winds blow from the southwest heavily laden with moisture. A different explanation is brought forward by another writer who attributes the delay in the northward migration to the extensive glaciers which flow from the mountains to the ocean. The forests of interior Alaska and northern Canada are of the Atlantic type and, sheltered behind the western mountain ranges from the coast influences, have continued northwestward so that the balsam poplar, paper birch, aspen and white spruce have intercepted the Pacific forest at Cook Inlet.

The influence of glaciers is seen in another instance. John Muir observed that the Sequoia forests of the high Sierras are in groups chiefly on the forest soil areas between the individual Sierra mountain glaciers now long since extinct. He points out that the broad gap between the northern and southern groves is exactly in the pathway of the great glacier that occupied the San Joaquin and King's River basins. The other great gap, forty miles in width, between the Calaveras and Tuolumne groves was directly in the pathway of the huge ice sheet that filled the Tuolumne and Stanislaus basins.

While the whole history of protoplasm and life is bound up with the history of the earth's surface and atmosphere, the instances above cited are comparatively recent events. Other and different examples of the operation of geological causes upon distribution might be multiplied, but the few already presented must, in this brief space, suffice as illustrations. It remains yet to consider the effects of existing influences. These influences constitute the environment and must be considered always in relation to the complex nature of the species.

Climate, of course, has a great deal to do with the distribution of plants, but not all. Witness, for instance, the rapid spread of plants introduced from foreign countries. Some of our most troublesome weeds are foreign plants spreading over the whole of the United States and growing more luxuriantly than at home. Nor should we conclude that all species in their present range have reached the limits of their natural extension in a *continuous* tract. Every species has its general climatic requirements, but these are seldom absolutely fixed. They fluctuate some-

times very widely between the minimum and the maximum of moisture and temperature, with a point somewhere between which is most favorable. And they are also susceptible of change as shown by the acclimatization of plants in cultivation beyond the limits of their natural range. It is quite obvious though that some plants require much more heat than others, and to determine just how much heat was required for putting forth leaves, flowers and fruit the phenologists sought to measure the quantity. Recording the mean temperature of every day after growth begins in the spring, they summed these means for each species up to the time of full leaf, flower or fruit. Thus one species may require a total of 100 degrees of temperature to come to flowering; another may require 500 degrees to reach the same stage. And it makes no difference whether the plant grows in latitude forty or fifty, it does not arrive at such stage until it has received its full quota, so to speak, of temperature units. This figures in the northward distribution since it is obvious that no plant can push its frontiers beyond the point where the temperature summations will permit it to bear seed. Since there is a condition of temperature most favorable for the production of seed in any species it follows that any departure from this optimum either way will slow up the vital processes, and if the departure is far enough will result in complete suspension of the functions. Accordingly, southward distribution of northern plants reaches its limits in another but no less effective manner.

Moisture is a prime requisite for all growing vegetation. The maximum is not so definite a point as in the temperature relation. Most plants will take all the water they can get, provided they are not smothered with it. The minimum point, as far as normal functioning is concerned, is that at which the cells begin to wilt, though the extent to which the loss of water can go without death varies widely among plants, some being easily injured by wilting, others, after drying to a crisp, being able to resume their customary vigor as soon as moisture is again available. It is evident to the observer that the widest differences in the size and structure of such organs as stems and leaves are expressive of the varied water relations of plants, as illustrated by comparison of desert plants with those of humid regions. Therefore, the extent to which a species can either conserve its water supply or get along with little measures its capacity to extend its range into dry or desert areas. Most desert plants are sun-loving organisms and will not endure shade and as soon as their soil is watered to the point of inviting less drouth-hardy species, they come into competition with more shade-enduring immigrants and may finally suffer extinction.

In North America as elsewhere the lines of stress as to temperature extend from east to west in relation to plant migrations, but the lines of stress as to moisture, owing to the topography of the continent and the direction of rain-bearing winds, are from north to south. Thus in crossing the continent from east to west we see the humid eastern section occupied by broad-leaved deciduous trees, then the prairies of the middle west, the plains of sage and sparse grasses, the wooded Rocky Mountains, the broad basin between the Rockies and the Cascades, the heavily for-

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ested Cascade Range, the open valleys of Western Oregon and the very heavily forested Coast Range, all frankly expressive in their vegetation of the varying amounts of moisture which they receive.

Temperature and moisture vary also with altitude and it is the play of one or the other or both of these factors that affects the distribution of plants at different elevations. Given a certain absolute quantity of moisture in the atmosphere there is an approach to saturation of the atmosphere with increasing elevation, due to its lessening capacity for holding moisture. This results in more frequent precipitation and retarded evaporation, a condition doubly advantageous for plants, and accounts for the difference between forested mountain sides and treeless plains below. Above a certain limit, however, the rapidity of heat radiation and consequent frequency of frosts operates to exclude trees first, then shrubs and finally low berbaceous vegetation. The operation of cold is twofold: first the actual depression of vital functions which comes with lowered temperature, and, second, the drying effect due to freezing of soil water and the consequent inability of plants to absorb enough to make good the loss through transpiration. Furthermore, the drying effect is enhanced by high winds. While summer conditions are usually accompanied by abundant moisture at high elevations the winter is especially the period of stress, when drying winds sweep the crests, reducing every exposed twig to brittle dryness.

Mountain ranges not only show important differentiation in the vertical distribution of their floras, but they also act as barriers when they lie athwart the pathway of a migrating species. And when several ranges lie parallel, as in the case of the Rockies, their effect is greatly increased and the mass elevation of the country over two or three hundred miles may effectually check the movement. Accordingly we see in this region the meeting of the Atlantic and the Pacific flora, rolling up like waves against a rugged shore, many thrown back, some few crossing over.

But other barriers may be even more effective than mountain ranges. Seas, icefields, deserts, plains, and forests may be absolute barriers to all plants except those adapted to their special conditions. It would be quite as impossible for the elm to migrate from the middle west across the plains as it would be for it to cross a sea, but it has succeeded in following the river bottoms slowly to some points in the Rocky Mountains.

Soil composition is less important than temperature and moisture in determining the distribution of plants. Most soils contain a sufficient quantity of the necessary ingredients so that, with the right amount of moisture and air, the majority of plants will grow without difficulty. There are cases, however, in which the species an area supports seems to be directly related to the chemical composition of the soil. Lime is supposed to attract some plants and to repel others. We are told of an interesting case in France. In a forest growing on siliceous soil there appeared a narrow streak occupied by plants found commonly upon limestone soils. These plants occupied no other part of the forest. Upon investigation it was found that the strip was the location of an old Roman road that had been paved with limestone. Fernald assembles

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the arctic-alpine plants of eastern North America into three groups associated with three kinds of soil of differing chemical composition. One of these soils, derived from granite, is rich in potash, the second abounds in lime derived from calcareous rocks of different kinds, while the third is from serpentine, bearing especially magnesium. These instances, however, concern small areas and the larger movements of plant races is on the whole little affected by any special chemical characteristics of the soil.

The foregoing is a consideration of the environment in one form or another on the distribution of plants. But the environment acts only in relation to the nature of the organism. In so far as the nature of a plant concerns temperature and moisture the kind of response it would exhibit might be inferred, but other matters of profound significance in the dispersal of species may have nothing to do with those factors. Such, for instance, would be susceptibility to disease. Certain valuable forest trees are predisposed to contagious and destructive diseases, which obviously curtail their reproduction and greatly reduce their vigor in competition with others, and may actually lead to the practical extermination of the species. A tree's demands upon light, as cited in case of desert plants, may result in its being but a temporary occupant of the land and its being supplanted later by more densely growing forests, in fact, this is the almost inevitable fate of such species, although much longer delayed in some cases than in others. Again the seeding habits of trees materially affect their progress. Given large capacity for seed production, beginning early in life and lasting into old age, the chances of success of that species would be greatly enhanced. Given also greater vitality, greater vigor of growth, greater facilities for dispersal and other advantages it might with assurance be expected that such a species would spread more widely and occur more abundantly.

Thus it may be seen that the distribution of plants over the earth's surface is a resultant of complex interacting forces. And it must be recognized that these forces are still actively at work and always will be as long as life retains its vigor and the struggle for survival goes on. It is conceivable that a delicate balance between the myriad forms of life might be reached in nature, resulting in a fixed condition of distribution and prevalence, but if that condition is reached it must be after evolution has ceased to originate new and vigorous forms, and when cataclysmic forces no longer open new tracts for conquest and occupation.

TRAILIN' (U. S. F. S.)

Git along, you Juno! Don't scrape that pack
Along that tree! That's right, step out,
There's ten long miles 'tween us an' sundown.
Wranglin', Packin', ridin'. This isn't
Just the picnic the movie places show.
A movie? Is there such a thing?
Five months back in the timber
An' no mail the last three trips.
Git along, you Juno!

JACK FROHLICHER.

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RECREATION IN THE NATIONAL FORESTS OF MONTANA

(Continued from Page 38)

Distinctive of the scenery of Montana are its mountains. For true mountain country, comparing very favorably with much in the United States or in foreign countries commonly visited by tourists, the region of the Beartooth is becoming better and better known. Granite Mountain, the highest point in Montana, 12,875 feet high, for many years reared its lordly head to a height and in a position made so impregnable by cliffs and ravines that no human foot reached its top until 1923 when three Forest officers, after braving much danger and hardship, officially planted the United States flag on its top. The Mission Range, forming the boundary between the Flathead National Forest and the old Flathead Indian Reservation, yields a wonderful panorama of craggy skyline of snow-capped mountains interspersed with the deep green of alpine timbers. The mountain sights are ever changing. Though the rocks themselves are eternal, the alternating sunrises and sunsets, the changing clouds, the sudden thunder storms, the varying play of lights and shadows continually thrill with new delights.

All these mountains are studded with nature's gems, the mountain lakes which, in their deep blue or green stillness, mirror the towering mountains which frown down upon them. One can find less wild and larger lakes lying at lower altitudes which are warm enough in summer to bathe in. Well-known and distinctive are Flathead Lake, lying close to a National Forest and the second largest body of fresh water wholly within the boundaries of the United States, and Seeley Lake, in the Missoula National Forest, a summer playground for many of the people of Missoula.

The streams and water courses, interspersed with water-falls, allow not only a great opportunity for fishing, but of themselves are delightful and restful to the eye.

Among the mountains are also to be found remnants of the prehistoric glacial period of this region. The Grasshopper Glacier, northeast of Yellowstone Park, in the Beartooth National Forest, is becoming increasingly known for its curiosity of a myriad of grasshoppers imprisoned in the ice, probably since prehistoric times. In the Glacier Creek country, north of Missoula about thirty miles as the crow flies, in the Flathead National Forest, there are very distinctive and unique glacial markings and scorings. This region has but recently been explored and in the near future will prove a Mecca not only to sightseers but to students of geology.

On the Gallatin National Forest, just north of Yellowstone Park, is a region containing many wonderful specimens of petrified trees. Along the Boulder River, on the Absaroka National Forest, where, geologically speaking, there is a distinct zone of contact between igneous and sedimentary rocks, there is some very unusually wonderful scenery and great opportunity for one who wishes to collect fossils of many varieties of the lower *forms of sea life of* prehistoric ages.

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On the Gallatin National Forest, just south of the City of Bozeman, is Middle Creek, whose score of water-falls, each of a different kind, will in future years become better known and perhaps even celebrated in song and story.

And there is not to be overlooked the great attraction of many and many miles of primeval Forest as untamed and beautiful as can be found anywhere in the Northwest.

The wanderer in the Forests may often meet some natural denizens of its wilderness. Elk, moose, and deer are plentiful in many localities. Mountain sheep and mountain goats yield much delight to the camera hunter. The innumerable smaller animals, prominent among which are the beaver, the mink and the martin, not only give pleasure but are a source of ever-increasing economic value in the fur trade. Plans are being made to increase their numbers.

Space does not permit a description of the infinite variety and number of attractions, and no one man in the compass of human life can hope to visit and benefit from all of them.

The National Forests are for use. Their recreational uses are for you, for me, and for every other citizen who wishes to visit them. Most of these are without charge or restriction. When special privileges are desired, they are available at a nominal fee. Forest officers are always glad to make anyone's visit as pleasant as can be, and when one visits the National Forests, he can feel that he is trespassing on no one's domain, but is viewing and enjoying a property which is in part his own.

It is not the purpose of the Forest Service in managing the National Forests for recreation to duplicate the functions, methods, or activities of the National, State or Muincipal Park services nor to compete with such Parks for public patronage or support. Recognition must, however, be given to occurrence within the National Forests of the very many features of recreational utility which are physically and geographically insceperable from the truly economic utilities. These utilities singly or in combination afford the basis for great out-door recreation contributing to the entertainment and instruction of the public or to public health, and constitute recreational resources of great extent, economical value, and social importance. There exists a great natural public demand for them and no plan of National Forest administration would be complete which would not conserve and make them fully available for public use. This use for recreational purposes of the areas now constituting the National Forests which began with the first settlement of the country will naturally grow as the population increases and as wild land is converted to cultivation. The preservation, development, and wise use of the recreational resources for the promotion of public welfare is recognized as an important and essential factor of National Forest management.

CUSTODIANS

Earth has provided for them all—
The seed, the twig, the tree,
And not an acorn she lets fall
About her thoughtlessly.
She has provided, where it fell,
The food for oak or pine:
Old Earth has done her duty well—
And how have I done mine?

Earth has attended all their days.
Their Mother Nature stands
To shield them from the burning rays
Beneath her leafy hands.
She will bring water from the sky
And food from fertile hill;
But if the tree shall live or die
Depends on human will.

Earth has erected beauty here,
Has labored long and glad,
Has given us for many a year
The hill-top forest-clad.
And now to you, to you and me,
She gives the verdant vale,
Custodians of all to be
For all—and shall we fail?

—American Lumberman.

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"Standard Quality" dry flies in all sizes and patterns (With or without snells)	$2.20 per doz.
Nature flies in twelve patterns, hook sizes No. 4 to No. 10	50c each
or	$2.75 per half dozen
Single spinners with "Standard" flies (any pattern	35c each
Single spinners with Nature flies (any pattern)	60c each
Tandem spinners with "Standard" flies (any pattern)	40c each
Tandem spinners with Nature flies (any pattern)	65c each

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It don't make no difference what title you got, it's what other people call you that counts.

Last season was fairly successful. Saw the supervistor twelve times, supervisor saw me twice.

I'm glad I don't get paid for overtime—wouldn't know what to do with all th' money.

"Say it with a home, and I'll grow the flowers," remarked th' new schoolmarm to our grazing assistant.

When you do a good piece of WORK, don't spell it backwards in tellin' about it.

Our grazing assistant has been combin' over the old game reports f'r a description of th' Red Dog the fellows talk so much about.

"There's a bright side to everything," said Ranger Sid, as he brushed off his old serge uniform.

It's a heap better to stand up an' fight an' git licked than to sit tight an' take a lickin.'

Super Bob says he'd rather have me wear a No. 11 shoe than a No. 10 hat.

GRAZING.

"This is food for reflection," said the goat as he swallowed the mirror.

A Forester is a guy who thinks you can tell the age of a bath tub the same as the age of a tree—by the rings.

Teacher: "Take this sentence: 'Take the cow out of the lot.' What mood?"

Willie: "The cow."—Kaimin.

VISION.

Forest Ranger: "Are these field glasses any good? Will they magnify?"

Clerk: "Well, sir, if you look at anything not over ten miles' distant it will appear as if it were behind you."—Literary Digest.

WE WOULD, TOO.

Sunday School Teach: "When the Prodigal Son returned home his father fell on his neck and wept. Why did he weep, Johnny?"

Johnnie: "I guess you'd weep, too, if you fell on your neck."

HANDY HINT.

A watermelon, cut longitudinally into strips, will, when fitted with the proper curved hooks, make a splendid set of coat-hangers.—Kaimin.

Ranger: "What are you doing?"
Smokechaser: "Helping the Lookout."
Ranger: "What's the Lookout doing?"
Smokechaser: "Nothing."

"I came in here yesterday and asked for a steak."
"Yessir, and will you have the same today, sir?"
"Yes, if nobody else is using it."

Botanist: "That's a new plant. Wonder what family it belongs to?"
Litte Boy: "Jones's."

Don't be so narrow-minded that your ears rub.

WAS YOUNG ONCE.

Faker: "Ladies and gentlemen, this is the skull of the great Christopher Columbus."

Professor's Voice from the Audience: "Why, that's the skull of a twelve-year-old child!"

Faker: "Sure, this is the skull of Columbus when he was twelve years old."

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Super: "What is the height of efficiency?"

Ranger: "*When you* can put your socks on from either end."

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DEDICATION

TO our fellow club member, Raymond Howard Bitney, in appreciation of a loyal heart and a ready hand, we, the members of the University of Montana Forestry Club, respectfully dedicate this volume

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WHY WE STUDY FORESTRY.

FIRE

There's a red-eyed witch
  in the woods today—
Her grey-blue hair
Is snaking up the gullies
On wind-twisted air;
Her hot and fetid breath,
Her fangs of flaming gold,
Are poisoning the forest—
Turning hillsides old;
Old with greying skeletons
Off dead trees standing there—
The dread witch of the timber
With her long, floating hair.

JOHN C. FROHLICHER.

MONTANA PLAYGROUND SCENE
(See page 87.)

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The Ranger's Shower Bath.

The Land of Shining Mountains.

THE PROFESSION OF FORESTRY

By DR. C. A. SCHENK.

Address to the Druids.

Dear Druids: I do not know whether the eulogies which the presiding officer showered on me are deserved. Eulogies should come after rather than before the affair causing them. And yet there is nothing in this world that gives to man so much buoyancy, so much of an uplift, so much of an inward happiness than the expression of friendship, of attachment, and appreciation. Indeed, the world would be much better off, if we, one to the other, were telling continuously how much we like him, cherish him and appreciate him—the Kingdom of Heaven would come close to us.

In Forestry, queer to say, there is not much of gratitude. Travel with me through the woods of Europe! Stand after stand I can show to you where the Oaks, clean as candles, are raising their heads to the sky; where the red bark of the Pine, in stands of 15,000 feet to the acre, is gilt-edged by the sunlight; or the stately Spruce of the Black Forest presents itself in its solemnity. But if you ask me who is the man to whom the world is indebted for the creation of those stands of Oak, Pine, or Spruce, I do not know; nobody knows; there is no monument devised to honor the Creator of these wonders. No, there is no thanks in Forestry. And yet there is that certain feeling in the breast of the man who has devoted his life to the woods, which is elating him in the conviction that he has been helping the Creator in re-modeling this world,—that he has been a cooperator of the Almighty.

Our *profession*, Forestry, is a wonderful profession indeed. *The practical Forester* is confronted with new problems and he must rely on his manhood, his stamina, his education in Forestry and his knowledge of men and of affairs to solve these problems quickly and correctly. I do not know, but it often strikes me that there is something almost divine in our profession. The contact with Nature seems to make it so: and I wonder whether it ever has struck you that the Child Jesus was growing up in a carpenter shop, and it may be that he had been whittling a stick of Lebanon Cedar or of Olive wood and that he had been studying the growth of wood to the divine forest —of a seed a seedling and of a seedling a tree—and I cannot help but feel that the man, Jesus, in his worldly occupations was a crafts-brother to myself—a lumberman. And then again, when the man Jesus wanted to gain strength and education, you remember he went to the hills where the trees were growing or to the groves of lives to commune with Nature and to commune with God.

And then there is that famous stick of timber—did you ever think of it—which was scaling 75 board feet measure or so, which was erected on a hill named Golgotha, which had the shape of a cross and from which has emanated all over the world all the good there is and that there ever will be. No wonder then that in Forestry these underlying ideals have a something holy, a something divine, a something inspiring in the daily toil, which makes our hearts beat higher and which upholds us in our ideals by the miseries of the day soon to be thrown in the mud.

I am getting old and old men are apt to become religious. For the last twenty years, aside from the study of Forestry, I have been trying to study this or that book on religion. Just let me say a word about immortality. If that immortality consists in sitting on the throne and in singing hymns, I personally do not want it. I have a poor voice and I am afraid Saint Peter would send me away from the choir to a place which is hotter but is far less pleasant. No, immortality is all that is good and the only immortality that is worthwhile is that immortality which consists of good that a man can do, and we Foresters in all our thankless professional work can justly bear in mind that whatsoever we do because it is good, because it is for the benefit of the people, because it reacts on the future prosperity of the Nation, is good and is immortal as is God himself.

In the old country, we have had since many decades, countless no-account Counts; aristocracy of blood. That aristocracy has always boasted of the wonderful deeds performed by their ancestors. Without a doubt there is something in the idea of the aristocracy of blood. Do we not blend all the fine aristocratic strains of sheep, of cattle, of horses, so as to immortalize the *stock* and better it for mankind? And is it not from that *Darwinic viewpoint* legitimate also to blend the aristocracy of blood *in man?* And yet, when you look over the annals of History, *where is the* aristocrat who has done anything in Chemistry, in

Engineering, in Mining, in Physics and in Electricity? Similar it is when we look at those upper Four Hundred in New York and elsewhere who claim to be the aristocrats of money. I have met, in the sixty years of my life, and notably when I was working for the Biltmore estate, many wealthy men, but I have yet to find the man who is made happy by the possession of money—or still worse, who makes others happy. When the moneyed aristocrat is in his villa in Bar Harbor, he wants to be at his apartment in Paris. When he is in his apartment in Paris, he telegraphs for his yacht to take him to Nice. When he is in his yacht he wants to be back on his estate in England—insanely wishing for what is impossible to obtain. Indeed "Bliss sought without, leaves you without bliss—bliss sought within, leaves you within bliss". And the latter bliss alone is communicative. Then there is another aristocracy—an aristocracy as old as is mankind, and I count it the aristocracy of Service. In my boyhood days, studying Greek, I was deeply impressed by the blessing which the Muses gave to Achilles—"Try always to do better than the best, devoting yourself to Service". It is the aristocracy of Service alone that has contributed to the advance of mankind, and it is the aristocracy of Service alone that has achieved the wonderful development of the United States. We Foresters, it looks to me, are the banner-bearers of the aristocracy of Service. We serve the people—by serving the people we serve the world, and by serving to the end of the world we are serving God. What is the use of a Christian who serves God merely on a Sunday? Every day of our lives must be devoted to a Service which in the last analysis is Service for the Almighty.

The blessings which are emanating from the Forests are manifold. There is navigation, there is the local climate, there is the food industry. recreation of the people, who are necessarily sub-served by the Forests and by the activities within the Forests. And there is the homing problem, the most important social problem and the most important problem in religion, in morals and in education for this reason: in the last analysis, what religion, what morals and what education we receive, we do not obtain in the school—we obtain and we did obtain it in the home by the influence of home life in connection with father, mother, sister and brother sharing the home. The Forestry problem of the United States is also the homing problem of the United States. When there is not lumber enough to go the rounds there will not be any more homes, for the large percent of the proletarians, and the danger looms on the horizon of all civilization being destroyed by Bolshevism, bred in the crowded slums of the cities. Thus it is that our profession is more than a worldly profession and is divine indeed, and those blessings come home *to those engaged in* it, not in worldly emoluments, but in that immortal feeling which the Creator must have had on the Seventh Day, when he found "That it was good".

You are young and I am old. Mine is a past and yours a future, and this future is sure to be so much more noble, so much more inspired, and so much more inspiring. You are Americans. The world is looking to America for leadership and it is up to you to see to it that America will lead the world!

SACRIFICE

The rowan-tree is like a candelabrum in the spring,
Its sleek, bronze branches tipped with silver jets of fire
That flicker to the heavens in a fair consummating
Of beauty whose dust shall be the seed of new desire.

MARY BRENNAN CLAPP.

Scene in the Mission Range.

Survey Party.

MONTANA BOUNDARY SURVEYS

By JAMES B. YUHL

Assistant Engineer.

Since the Treasure State with its untold wealth and undeveloped resources is to be featured in this years issue of the Kaimin, it is appropriate to include some information relative to its extensive boundaries. Kaimin readers will probably be interested in the conditions under which these surveys were made.

The maximum dimensions of the State of Montana in cardinal directions are about 540 miles by 275 miles. The perimeter is approximately 1910 miles and the area is about 146,080 square miles.

The international boundary between Canada and the United States is the north boundary of the State. That portion extending west from the crest of the Rocky Mountains to its intersection with the Montana-Idaho boundary was first surveyed by the International Boundary Commission (British and American Engineers), during the period 1859-1862. The survey was finally abandoned until after the Civil War. The remainder of the north boundary extending east from the crest of the Rocky Mountains was surveyed shortly after the Civil War, during the period 1872-1876. The length of the north boundary is 546 miles.

That portion of the south boundary common to the States of Montana and Wyoming was surveyed in 1879-1880 by Rollin

J. Reeves under the supervision of the General Land Office, and covered a distance of about 348 miles.

The east boundary was run on the 27th meridian west of Washington, by the United States Geological Survey in 1885, and is approximately 276 miles long.

The west boundary from the intersection of the 39th meridian (west of Washington) with the crest of the Bitterroot Mountains was run north to the international boundary, a distance of 70.7 miles, in 1898 and 1899 by the U. S. Geological Survey.

The remainder of the boundary, which is 667 miles in length, was run as a traverse along the crest of the Bitterroot Mountains for 355 miles and thence along the Continental Divide for 312 miles to the Wyoming line. It forms a part of the south and west state boundary and was surveyed by Howard Carpenter under contract with the General Land Office in 1904 to 1906. This is the only portion of the boundary that did not follow either lines of latitude or longitude.

The earliest survey was started 66 years ago and the most recent was made 20 years ago. It will therefore be seen that a period of 46 years had elapsed between the starting and completion of Montana's boundaries. It did not take 46 years to make the surveys but the natural development of the West necessitated that these surveys be made during this period. The actual surveying probably was done in about 15 field years. But it must be remembered that the average field season is only about four months in length and therefore the actual surveying time on a year-long basis would be about five years. At this rate nearly four hundred miles per year (not a field season) were surveyed.

Today railroads, the airplane, the automobile, improved instruments and methods and the network of roads and trails which covers the majority of the State has greatly facilitated the problems of the modern surveyor. The pioneer surveyor was not confronted solely with surveying problems. His principal worries were the physical difficulties of transporting his supplies, camp equipment, instruments, iron monuments, and other surveying paraphernalia to suitable locations near where his surveying activities were to be carried on. In virgin territory he had to build trails and he was continually hampered by freshets and high water in getting to his work in the spring and blizzards and snow storms while returning in the fall. Then, too, he was miles away from his base of supplies. He had to have pack trains sufficiently large to handle provisions in large quantities. He was not as fortunate as the modern surveyor who can send a truck to the country store for supplies and receive what he needs in a day or two. Even with a packtrain he is seldom over a couple of days' journey from a supply base. Forty years ago the majority of freight for the eastern part of the state was brought up the Missouri River by boats to Fort Benton, which was then the head of navigation and the distributing point. From Fort Benton it was moved on freight wagons by mules and oxen as far as the few trails (they could hardly be called roads) would allow. The remainder of the journey had to be made by pack-trains, in which large numbers of mules and horses were used. In addition to the physical difficulties of transporting his outfit the pioneer surveyor was confronted with one troublesome situation that is unknown to-day. It was usually necessary to include a detachment of cavalry to protect the surveying party from attacks by the Indians. Extracts from field notes of some of the earlier surveys will appear later in this article.

According to the fable of the cherry tree we have been taught to believe that the Father of our Country wielded a mean axe. At this early age the natural inclination which made Washington one of the foremost woodsmen and surveyors of his time was apparent. Not only was he noted for his famous bonfire system of surveying by night but he also introduced a literary style of writing field notes that became very popular in later years. He believed that anecdotes and personal experiences of the surveyor should be introduced into the notes to make them more fascinating to the reader. There is a marked difference in these earlier notes from the present-day notes which are dry reading like so much statistics. The field notes of many of the earlier surveys read like romance or fiction and are extremely interesting. Washington's style is very much in evidence in the field notes of Rollin J. Reeves in his survey of the Montana-Wyoming boundary in 1879-1880. The following extracts are from these notes:

"On the evening of September 6, 1879, after quitting work on the line, our party started down the mountain to find camp; we divided into five smaller companies. The camp was not found until noon of the next day, all hands having lain out without shelter or food since the morning of the sixth. I walked fully twenty miles in trying to find the pack-train and I think others traveled as far. We had no guide and the country was strange to us all. The descent to the Yellowstone River was down an old Indian trail, very stony, steep, dim and dangerous. The crossing caused some solicitude on account of the huge boulders scattered over the bed of the river.

"The most noteworthy objects of general interest near this portion of the boundary are the Mammoth Hot Springs and the buildings, roads, and other improvements near it; and the Clark's Fork mines and their surrounding improvements. A blockhouse strongly and carefully built during this summer (of 1879) by Colonel P. W. Norris, Superintendent of the Yellowstone Park, is used as the headquarters of the

HAYNES PHOTO — NORTHERN PACIFIC RY.

Stage Coach.

Superintendent and employees. It stands on a hill about one-quarter of a mile northeast of the great hot basin, is in a commanding position and is in strength, finish and design one of the best blockhouses I ever saw. It is two stories high, contains six large rooms, has a cupola and flagstaff. . . .

"A man named McCartney keeps a hotel on the reservation near the hot springs. He sells bad whiskey, encourages gambling and charges exorbitant prices. He has no permission or authority to live on the reservation, and should be put off, although it would require physical force to do it. . . .

"Nearly all the streams and lakes abound in fine trout. Those caught in Gardiners and Yellowstone Rivers were sweet beyond description. Those caught in Slough Creek, Soda Butte Creek and Lake Abundance were also delicious, and many of them weighed four and five pounds. Our party, averaging in number sixteen men, and the company of cavalry, our escort, averaging fifty men, were kept constantly supplied with fish and game from the time we left until we returned to Fort Washakie, nearly three months. Elk, deer, antelope and rabbits were as numerous over the entire region as dogs in an Indian camp. There were hunters with us who were especially skilled; one man in particular never going out and returning without game, so far as I ever heard. Our camp was constantly supplied with fresh meat. We saw but one buffalo while engaged at work on the survey, but on our march home we saw hundreds, and killed several; seven in one afternoon. The personnel of the surveying corps, having been reorganized since finishing the Colorado-Utah line, was carefully selected. It was made up mainly from mountaineers; was adapted to this life and work; and the surveying was cheerfully and well done. It has been several years since I have been associated, in the field, with as efficient, faithful and agreeable a company of assistants as this one proved to be, and we were all sorry when the work had to be abandoned so early in the season. . . .

"Leaving Washington on the 29th day of May, 1880, I arrived at Fort Washakie, Wyoming territory, on the 13th day of June.

"From this Post K. Company of the 3rd U. S. Cavalry, Capt. G. Russell, commanding, had been detailed to act as our military guard during the summer. . . .

"We arrived there just as the mountain streams began to swell. We found it impossible to ford Big Wind River, eighteen miles north of Fort Washakie, and which we had to cross to reach the Line. After trying for two weeks to get across, I had a boat built and hauled from the post to the river. Then on the 28 and 29th of June I crossed my own party, and the military on the 1st of July. Up to this point I had come 170 miles overland from the railroad. We now marched about 300 miles, almost due north, to the Crow Indian Agency, where my instruments, animals and some supplies had been stored during the past winter. We arrived there the 15th of July. There I partially organized a party, and with eleven men, started on the 19th day of July for the initial point of this year's survey, which we reached on July 30, having had to travel over rough region 150 or 200 miles from the Crow Agency. Thus it will be seen that I had to travel a distance of more than 600 miles from the railroad, mainly on horseback, to reach the beginning point for the survey. . . ."

It should be noted that it took Mr. Reeves from May 29 to July 30th, practically two months from the time he left Washington till he arrived at the initial point of survey. It should also be noted that it took from the 13th of June till the 30th of July, about a month and a half, to travel 600 miles overland. During this 600 miles he averaged about 13 miles per day. To-day with our improved road system and trucks for transportation this entire distance could be covered in three or four days. If airplanes were used the distance could be covered in a few hours.

Custer Battlefield.

"The travel above noted, was attended with the usual camp hardships, and some extraordinary perils in the way of crossing rivers. Beside Big Wind River we had Owl, Grey Bull, Stinking Water, Clarks Fork and Rocky Fork to cross at their highest stages of water. The crossing of each was attended with much real danger. In swimming Clark's Fork River I was compelled to leave my horse, and swim ashore, after being severely kicked while in the river. All the animals had to swim with their packs on. . . .

"We now numbered eighteen men. We had forty-two animals, about twenty-five were used exclusively for packing They consisted of horses, mules and jackasses; twelve of the latter. I refer in these numbers to our surveyor's outfit. The military had a separate organization consisting of some fifty men and about 100 horses and mules."

It will be seen that the entire organization consisted of 68 men and about 142 head of pack animals. To-day about the largest survey crews consist of twelve or fourteen men and about the same number of animals. In the majority of cases survey parties are equipped with autombiles and trucks.

The following extracts are taken from U. S. Geological Survey Bulletin No. 170, and describes some of the conditions under which the International Boundary (north line of the State) was surveyed, during the years 1858-1859-1860 (65 to 67 years ago):

"The work of running and marking the land boundary was carried on thru a country previously almost unknown. *The 49th parallel* extends over rugged and precipitous mountains that attain great elevation . . . perpetual snows covered many of the peaks. . . . The timber on the western slope . . . being a heavy growth of pine and fir that in many places stands over a fallen forest not yet decayed. . . .

"Trails had to be opened for three-fourths of the distance traveled, involving great labor in cutting, grading and bridging to make the route practicable for pack mule transportation. The water courses were numerous and rapid, rendering the fords frequent and dangerous, and a slight rise of many of the streams would have made them impassable but for the timely precaution of building bridges at small streams and ferryboats at the river crossings."

The foregoing extracts from notes and reports of the earlier surveys describe the conditions and hardships under which the boundaries of this state were made. Many interesting phases, such as the transportation and erection of milestone monuments and the cost of various parts of these surveys, have not been touched upon in this article because space does not permit. To those desiring further information relative to the exterior boundaries of this great Treasure State you are referred to U. S. Geological Survey Bulletins Nos. 170 and 689, and also to the survey notes of the north boundary of the territory of Wyoming.

"SUGGESTIONS"

Dreaming of Indian tales
In the shadow of old Sentinel.

    Trees marching in single file
Across the mountain top;
Lone pine sentinels signaling from crag to crag;
Tress in a mass below
    On the hillside.

    Indians marching in single file
Tepees pitched in a row;
Indian sentinels overlooking the valley on
An army encamped below
    On the hillside.

DOROTHY AKIN.

The State Forests Provide Employment.

MONTANA STATE FORESTS

By R. P. McLAUGHLIN

State Forester.

It is a pleasure to report to the Kaimin and the Kaimin's friends that some progress has been made in State Forestry during the past year. Last year I endeavored to present to Kaimin readers the idea that the State should engage permanently in the forestry business, because it is not only profitable to do so, but a duty, in order to preserve our forest resources.

The legislative assembly of 1925 thought so too, and passed a law creating State Forests, and providing for the regulation of their use, management, control and disposition. All lands at present owned by the State of Montana, or hereafter acquired, that are chieflfy valuable for the timber that is on them, or for growing timber, or for watershed protection, are classified and designated "State Forests", and reserved for forest production and watershed protection. The law then goes on to name seven State Forests already in formation and under process of consolidation. Thus, from an abstract idea, Montana has taken the initial step toward a concrete State Forestry program.

State Forests Created

The State Forests created under the new law are as follows:

	Acres
Stillwater State Forest	90,000
Swan River State Forest	42,000
Coal Creek State Forest	20,000
Sula State Forest	10,000
Thompson River State Forest	14,628
Clearwater State Forest	18,076
Lincoln State Forest	8,245
	203,949
Forest Sections scattered thruout the State	363,000
Total	566,949

While the establishment of the seven State Forests named above is a forward step, the large acreage of forest sections scattered thruout the State shows that much remains to be done in blocking up the State Forests and securing their consolidation. The goal of State Forest consolidation should never be lost sight of, and the establishment of the seven State Forests named, is one of the means to that end. Some of these State Forests are in themselves more or less checkerboarded. Exchanges of scattered forest sections have been and are being currently effected to consolidate these checkerboard forests, where such exchanges are possible with the United States Forest Service. Complete consolidation, however, cannot be had until legislation is enacted, authorizing exchanges with private timberland owners. The current exchange work with the Forest Service involves the examination of nearly 200,000 acres—of which 100,000 acres are scattered forest sections, and 100,000 acres are government land, to be considered in making lieu selections. Last summer 38,000 acres of State land and 40,000 acres of government land were cruised and examined jointly by the State and the Forest Service.

Obsolete Laws Repealed

Another indication of progress is that many obsolete and antiquated laws were repealed, especially those that authorized a dual administration of forest lands by the State Land Office and the State Forestry Office. Dual administration of forest lands has been heretofore the cause of misunderstanding, friction and mismanagement. The practice also made friction between the timber purchasers and the lessees of the lands, who found themselves respectively on the land, each with State authority to do certain things, that in themselves were incompatible with one another. Mismanagement was the result. This fact, and the possible illegality of the practice was brought to the attention of the State Land Board, which authorized all secondary uses on State Forest lands, such as grazing and the like, to be conducted by the State Forester. The new law provides that grazing on the State Forests, and all secondary uses be administered by the State Forester.

State Forester to Have General Charge

Under the new law the State Forester, who must be trained and experienced in forestry, will have general charge of all the State Forests. With the approval of the State Land Board, he is authorized to prepare all the regulations in conformity with the text of the law, pertaining to all the activities of the State Forests. Some of the other duties of the State Forester under the new law, are as follows:

To administer the Forests.

To examine, estimate and appraise the timber crops.

To sell the timber crops with the approval of the State Land Board.

To sell the other crops of the forest.

To advertise the timber for sale.

To accept or reject bids for timber crops with the approval of the State Land Board.

To award the sale to the highest responsible bidder.

To secure a formal agreement in writing for the sale of the timber.

To secure a bond from the purchaser for faithful performance of the contract.

To define the rules of silviculture, cutting, utilization, scaling and slash disposal.

To define such other rules as are essential to the perpeptuation of the State Forests.

To secure payment for timber in advance of cutting.

To suspend cutting or removal of the timber upon breach of contract.

To take other steps upon advice of the Attorney General, to adjust the breach or liquidate the State's claim for damages.

To issue free permits for certain timber for fuel.

To issue commercial and domestic permits for certain timber.

To supervise all timber sales.

To employ and fix salaries of all forest wardens, scalers, cruisers, estimators and forest assistants.

To instruct and supervise all employees in their work.

To require a scale of merchantable saw logs by the Decimal C log scale.

To require numbering of logs and entering of scale of each in scale book.

To retain the scale books as a public record, identified with the *specific sale* and the particular scaler or scalers, *who did the work.*

To require that each log be stamped with the State mark "S-T".

To examine, classify, select, appraise and reappraise the State's forest lands.

To administer the grazing and all secondary uses of the State Forests.

To establish his office upon the State Forests, or at some place accessible to them.

To publish a report biennially of the State Forests' condition and activities.

To cooperate with forest owners in the protection and development of their forest lands.

To cooperate with farmers in the development and protection of plantations, shelter belts and brush disposal areas.

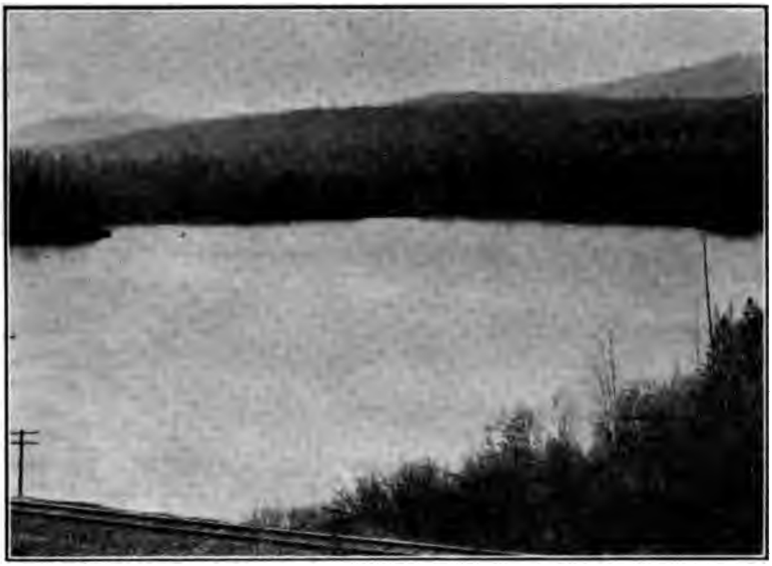
Activities and Improvements

During the past four years the State Forestry Department has been engaged in many activities that have improved the forests. The revenues for the past four years have been over $424,000. The areas cutover have been left in productive condition. About 125,000 acres of forest lands have been examined and classified. In cooperation with the United States Forest Service, about 38,000 acres of State Forests and 40,000 acres of government lands for lieu selection, were intensively examined. Besides this, approximately 200,000 acres of public domain have been covered by extensive timber survey for the purpose of determining other areas for lieu selection.

The protection of the State Forests has been very much strengthened. By means of federal aid secured in cooperation with the United States Forest Service, the Stillwater State Forest in Flathead and Lincoln counties has been greatly improved and developed in all protection facilities. There has been built on Dog Mountain a steel lookout tower, 35 feet high, which has added a great deal to the detection system on that forest. The organization there is completely equipped to handle forest fires. The equipment consists of standard fire fighting tools, tentage and kitchen mess sufficient for a crew of 30 fire fighters.

Because of a great amount of travel thru this forest, and numerous logging activities, the organization is equipped with an Evinrude engine and 2000 feet of fire hose, all of which can be quickly loaded into the State's Ford truck and transported to any fire adjacent to the highway. This equipment is also portable by pack-horse.

A class of forest school students, under the direction of Professor Skeels, made studies on the Stillwater State Forest *last summer*, for the purpose of constructing a forest working *plan*. For lack of funds, their work cannot be completed *this year*, as originally contemplated.



State Forest Scene.

As fast as the exchanges effect the consolidation and enlargement of each of the State Forests, corresponding activities may be looked for, and protection and other improvement facilities must be provided.

State Forests Self-Sustaining

The revenues from Montana's State Forests are far above the costs of protection and administration. Our State Forests are therefore in reality self-sustaining. The legislature, however, appropriates money from the general fund to protect and administer the State Forests. The source of the general fund is taxation. In practice then, the expense of our State Forests is borne by taxing the people.

It seems to me that the State Forests, except perhaps in times of emergency, should be wholly self-sustaining. Under the present practice, however, the State Forests are self-sustaining only in theory. The State Forests are composed of forest lands of different grants. Under what I think is a mistaken practice, the revenues from the sales of timber crops are placed in the permanent funds of the respective grants, and are therefore not available to the institutions to which the grants are made. Interest therefrom, however, is available. and this is where the whole structure of our State land receipts seems to be wrong. It would be absolutely impossible for a farmer or a business man to conduct his business on the same theory. A farmer grows his crops, harvests them, sells them and pays the entire expense of his farm project from the proceeds of his crops.

Under proper forest management there is annually a crop of timber. The sale of this timber is a source of revenue. So long as this revenue is more than adequate to protect and administer the State Forests, the burden then of forest administration should not fall upon the people in the form of taxation. I can see no justification for treating the revenues from sales of timber crops, as creditable to the permanent funds. Grazing and other rentals are creditable to the income funds. In both cases, the soil or land (capital) remains in the ownership of the State. When, however, the land, timber and all, are sold, (now an obsolete practice), the revenues therefrom compose the capital investment and belong in the permanent funds, of course. It seems to me that the State Forests need not be a burden of taxation upon the people, only in great emergencies or temporary fluctuations of the timber market, where sales for a period are inadvisable. Instead of building up a great permanent fund for investment purposes, the interest from which is only available to the grants, it would be better finance to treat the revenues from timber crops as incomes from the forest soil or capital, and make those net incomes, after deducting the cost of protection, administration and extension, available to the institutions of the respective grants. The State Forests could then be managed more wisely as an investment proposition. The several institutions would benefit by greater and more direct income. Taxation could then be reduced and the burden of government cost spread.

Montana Forest Scene.

Forest Scene.

SERMONS IN TREES

By C. H. CLAPP.

Nature has freely, lavishly supplied us with her great gifts of energy, but at the same time imposes upon us an obligation to use her gifts properly, or as we say, in accordance with natural laws. The proper use of Nature's gifts is true conservation, not mere saving or hoarding but use, abundant, plentiful use, but not waste. In spite of anything that we may do, certain resources, such as our great mineral resources are bound to be depleted in time. Other resources, on the other hand, may be conserved in such a way as not only to be utilized to the maximum, but to be passed on to future generations enriched rather than impoverished. This is true of our great agricultural areas, especially those recalimed from the desert by irrigation. This may be true of our great forests, but our forests, especially of the United States, have been in the past waning, rather than as they should be waxing, resources.

To change this condition is the great purpose of forestry. Forestry and conservation, conservation and forestry, the two words are almost one so closely are they linked in our minds.

To accomplish this great purpose requires the correct solution of countless problems in the scaling or measurement of trees, the cutting and utilization of lumber, the prevention and control of forest fires, and the planting of new trees. These are problems which require more than just technical skill and experience for their solution, because they call for new solutions. Yet, all too frequently, foresters like engineers and other professional men are seemingly content with mere technical proficiency and then wonder why their jobs do not bring greater profit and more satisfaction and happiness in their achievement. Such men have succumbed to the dangers of specialization, have been unable to aim in learning how to shoot, have been unable to see the forest for the trees. They have forgotten that technique is not in itself sufficient but is an aid to such essential qualities as imagination and sympathy, reliably and courageously disciplined and tested by systematized facts, experience, and fundamental principles, which themselves have been discovered by imagination from systematized facts and experience and tested by them. They have forgotten that no learned routine can take the place of thinking.

Surely forestry with its demand for careful, accurate, and reliable observations, its demand for foresight and judgment, its demand for courage and discipline cannot help but develop these qualities unless prevented by too narrow an outlook. Surely no one can be a forester and not feel the appeal of conservation, with the consequent development of his imagination and his appreciation of his obligation to others. Nature freely supplies us with her gifts but at the same time imposes an obligation to use her gifts properly.

As we of this generation are the heirs of the wealth of former generations derived from Nature through thinking, so are we also the trustees of future generations, obligated not only to pass on to them the wealth we have inherited, but to add to this what new wealth we ourselves can create. This appears to be a natural law from which there is no escape. And just as surely as punishment is inevitable from its disobedience or neglect, so great rewards follow its proper observance.

Deer in National Forest.

GAME MANAGEMENT IN THE NATIONAL FORESTS OF DISTRICT ONE

By GLEN A. SMITH

Assistant District Forester.

From the earliest times, Forestry has been associated with game and fish production. Back as far as the year 1598 the Englishman, Manwood, in his treatise on the "Laws of Forests" defined a forest as "a certain territory of woody grounds, fruitful pastures, privileged for wild beasts and fowls of forest, chase, and warren to nest and abide in, in the safe protection of the king."

Since Manwood's time, the functions of the forest have *greatly increased,* so that instead of being solely valuable as

Hunting in Montana.

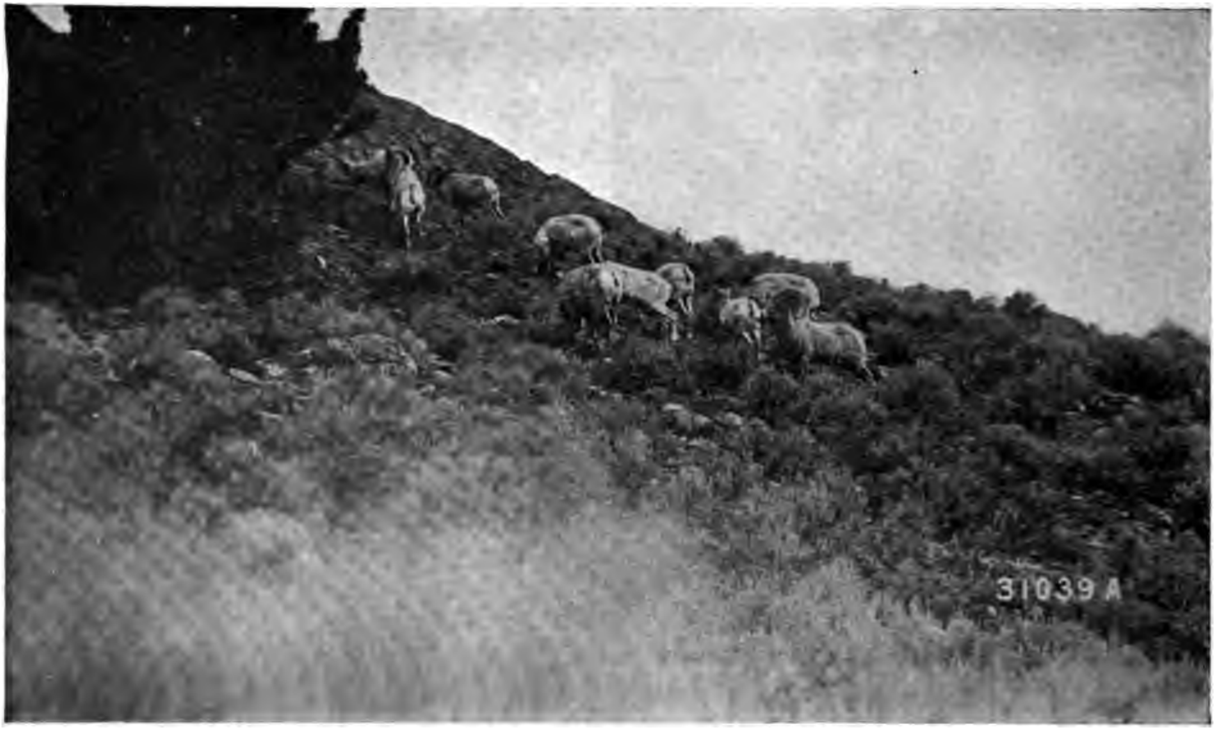
a pleasure ground, they are now chiefly valuable for the production of wood and the conservation of water, but their usefulness for recreation and as a home for wild life is still very great and in their management this value should receive full consideration.

With the creation of the National Forests a condition was created whereby a more systematic study and definite plans of management could be worked out for the perpetuation of the wild life they contain. During the past few years progress has been made in securing the fundamental data for rather definite plans of game management. As in any undertaking. the first essential is an inventory of what we have to deal with. It is realized that our information to date is not accu-

Ptarmigan.

rate and that twenty years hence it will be regarded as very crude. However, a start has been made even though it may be crude. Practically all Forest officers are commissioned by the state game warden as deputies and are instructed to report and prosecute game and fish law violations to the same extent that they execute their other duties under United States laws and departmental regulations. Study of game conditions, including such things as adaptability of ranges to classes of game, seasonal condition of game, increase and decrease in game herds, loss from predatory animals and other destroying agencies, the division of range between game and domestic stock, the dual use of range by game and stock, the carrying capacities of game ranges, and many other game problems of similar nature, is a part of the regular job of Forest Service employees. These studies are all summarized in an annual report from each man and are used as the basis for building up a game management plan for each of the National Forests. This work is done from the standpoint of Uncle Sam as a property owner who desires that his land shall be so managed as to render the highest possible returns to the community in which it is located, and to the nation as a whole.

Estimates of the amount of game within large areas of wild land can, of course, only be very rough ones but those



Mountain Sheep.

given out by the Forest Service are made up by the rangers who spend their time working over their districts and making as close observations and tallies as possible, including winter counts. No accuracy is claimed for the following figures, but they are at least the best that are available. The last annual game report of the Forest Service shows the following numbers of big game within the National Forests of the State: 985 moose, 8,400 elk, 50,000 deer, 680 antelope, 1,875 mountain sheep, 2,480 mountain goats and 20 caribou.

SOME OF THE PROVISIONS MADE FOR GAME IN THE NATIONAL FORESTS OF DISTRICT 1

	Acres
Net area of National Forests in District 1	22,338,253
State and Federal game preserves in National Forests in District 1 closed to grazing	1,348,798
Percent of National Forests in preserves District 1—6%	
Area of waste and timbered range in National Forests District 1 used only by game	10,813,896
Gross area used only by game includes preserves, inaccessible range and areas closed for protection purposes to domestic stock	12,454,257
Percent area in National Forests of District 1 used only by game of net total—56%	
Estimated area summer game range in National Forests District 1	15,970,364
Estimated percentage winter game range in National Forests District 1—27%	
Estimated area winter game range in National Forests District 1	6,087,889

The great need now is for a general recognition among the sportsmen and foresters of the State that game propagation and conservation is not merely a question of law enforcement, but one of biology and economics,—intricate and far-reaching, that cannot be solved by rule of thumb, or by opinion based on meager knowledge of only a few of the facts. If we are going to progress as we should, there must be a more general recognition that accurate and scientific knowledge of all facts are just as applicable in administration of game matters as they are in the handling of any other complicated business, and that the opinion of any one who has not made a study of the biological and economical conditions on the question of perpetuating Montana's wild life is worth just as much and no more than that of the average layman on how to build and fly an airship. To the extent that this fact is recognized by the sportsmen and foresters of the State they will see to it that provision is made for carrying on the work.

A "Few" Ducks.

THE CALL

In far-flung phalanx through the misty sky
The wild geese hasten north;
All through the April night their clarion cry
Comes winging down where sleepy humans lie
To bid them hasten forth.

The geese call clear. I know the things they mean,
So I must pack and go
To watch the mountains lose their silver sheen
And see the upland grasses, young and green,
Push back the winter's snow.

JOHN C. FROHLICHER.

THE FORESTS OF THE BITTER ROOT MOUNTAINS

By J. E. KIRKWOOD

The Bitter Root Mountains form part of the boundary between Montana and Idaho. As defined by the U. S. Geological Survey the Bitter Roots proper extend from Lolo Pass southward to the head of the Little West Fork of the Bitter Root River, a distance of about 70 miles. On the south they connect with a westward extending spur of the main range of the Rockies, an elevation of different geological formation; on the north they adjoin the Coeur d'Alene Mountains which extend north and west dividing the tributaries of the Clark's Fork and the Snake. The highest point in the Bitter Root mountains is Trapper Peak with an elevation of 10,175 feet, standing near the southern end of the range. Several other peaks rise to 8000 and 9000 feet or more. The elevation of the passes is mostly about 6000 feet, although Lolo Pass reaches only 5254.

The topography of the range is rugged and picturesque, especially toward the southern end where deep and narrow gorges are flanked by lofty and precipitous peaks. The eastern slope rises rapidly from the Bitter Root River to the crest at a distance of fifteen or twenty miles whence the western slope falls away by more gradual stages to the Clearwater Mountains, which constitute a wide and deeply dissected plateau-like region having a general elevation of around 6000 or 7000 feet but with occasional summits reaching 8000 to 9000.

On the east the drainage consists of numerous small streams flowing by more or less direct course to the Bitter Root River. On the west flowing via the Clearwater to the Snake River are three or four large streams, the North Fork of the Clearwater, the Lochsa, the Selway and the Salmon rivers, which gather their waters from numerous tributaries whose ramifications follow a bewildering maze of narrow canyons. The whole area extends about 100 miles north and south by 70 or more east and west.

In this region the rain-bearing winds come from the west and southwest, resulting in a heavier precipitation on the western slope, in fact the rainfall on the western side of these mountains may safely be estimated at three times the amount which falls in the Bitter Root Valley to the east. At Hamilton on the Bitter Root River the average of a number of years observation is less than 11 inches of annual precipitation, and at Missoula about 50 miles north, about 16 inches constitutes the annual mean. The areas lying from 30 to 50 miles west of these points may be considered as having from 33 to 50 inches a year. In the northern part of the Clearwater drainage the heavier rainfall is a feature of the climatic conditions of a much wider area extending through the lake region *of the Coeur dAlenes* and northward. Toward the south the

influence of the semi-arid Great Basin appears, gradually diminishing the summer rains and winter snows. Necessarily the differences in the precipitation are sharply reflected in the vegetation of the areas, both as to the constituent species and the density of the plant covering. Likewise differences in elevation are attended by differences in precipitation and temperature, in length of the growing season and other factors which also modify profoundly the size, numbers and species of plants.

The forests of the Bitter Root and Clearwater mountains are a part of the general Rocky Mountain Forest, which is prevailingly coniferous, evergreen. It comprises fifteen or sixteen species of gymnosperms, viz., yellow, white, whitebark and lodgepole pines, western and Lyall's larches, Engelmann spruce, mountain hemlock and probably also the western hemlock, Douglas spruce, grand and subalpine firs, arbor vitae, dwarf and Rocky Mountain junipers and western yew. In addition to these a few hardwoods are present, as the black cottonwood and aspen, willows, alders, birches, hawthorns, choke cherries, and the cascara *(Rhamnus Purshiana)*. Of these the white pine, mountain hemlock and cascara are mostly confined to the west side; while the others appear on both sides the difference in their prevalence and distribution is quite marked. Thus the lower limit of forest distribution on the eastern slope is about 1700 feet higher than on the western. For the lodgepole pine it is 1000 feet higher, for the Engelmann spruce 1500 feet, for the Douglas spruce 1700, for the grand fir 2000, similarly the lesser vegetation of herbs and shrubs are affected by the same influences.

From these facts it follows that the life zones are tilted toward the west. These zones, according to the system devised by Merriam, are in this region the Transition, Canadian, Hudsonian, and Alpine as we proceed from the valleys to the highest peaks. They are the expression of the different temperature requirements of plants and animals and while they show more or less overlapping and intergradation, nevertheless furnish a convenient and natural basis for the expression of the differential distribution of the fauna and flora of North America and are applied with reference both to latitude and altitude. Of the two main regions, northern and southern, we have only the northern, with its zones mentioned above. The Transition is a broad, or sometimes narrow belt of overlapping and intermingling northern and southern elements. Next northward or above in altitude is the Canadian zone marked largely by vigorous coniferous forests, then the Hudsonian, also coniferous but less vigorous and often dwarfed and crippled by cold and marked usually by other conspicuous features, and finally the Arctic-Alpine consisting mainly of low plants in an area beyond or above the limits of tree growth.

Transition Forest Yellow Pine.

In this region the Transition, or Arid Transition as it is better known, is characterized largely by yellow pine, sagebrush, bunch grass, balsam root, puccoon and numerous other plants which occupy the prairies and open pine woods. In the Bitter Root Mountains one finds this zone chiefly along the eastern foothills of the range somewhere between 3200 and 4000 feet elevation. On the west slope it hardly appears at all except in patches along the Selway River on bold bluffs facing the south, or farther south where it becomes more conspicuous as it nears the Snake plains. The areas where it was observed along the Selway were between 2500 and 3000 feet. Another aspect of the Transition zone is seen west of the Cascade Mountains in Oregon and Washington and is known as the Pacific Coast Humid Transition. It is characterized by the Douglas spruce as the dominant forest tree with grand fir, arbor vitae and western hemlock among the gymnosperm and by maples, cascara, the flowering dogwood, ash and other hardwood trees. In most parts of the Clearwater drainage there is some expression of this form of the transition forest and there is a very strong expression of it in the northern part of the area where the arbor vitae, grand fir, and many herbs and deciduous shrubs give the forest an aspect much like that of the northwest coast country. It is found that wherever in this region Pacific coast conditions prevail there are generally assemblages of plants which both in their specific identity and in their ecological structure suggest a relationship to that region. It is evident also that much of our flora has been derived from the coast country by eastward migration and it is but natural that such plant immigrants should settle in those spots which they find congenial. The number and identity of such species and the limiting factors in their movements are therefore matters of interest to the botanist.

The Canadian Zone in the northern Rocky Mountains is characterized not so much by peculiar and exclusive species of forest trees as by the density of the stand and the general ecological features of the forest. The yellow pine gradually disappears, owing doubtless to its being shaded out by more tolerant species. The Douglas spruce which we have noted in connection with the humid transition of the coast, and which shares with the yellow pine the arid transition of the Rocky Mountains often constitutes a considerable part of the Canadian forest zone. It is unquestionably the most widely adaptable species of our western forest trees, thriving at sea level on the coast or contending successfully with other species at 6000 feet in the Rocky Mountains, flourishing under a rainfall of 50 to 100 inches a year or struggling along on less than 12. The western larch is likewise a member of the Canadian forest, as is also the lodgepole pine and Engelmann spruce.

In the Bitter Roots the Canadian Zone forms the bulk of the so-called Montane forest at elevations from 4000 to 5000 feet, and in places up to 6000 or above. It is not in any case a timber line forest, although the timber line species descend into it. The zonal breadth and elevation vary especially with reference to exposure in relation to sun, wind, snowfall and other factors which bear upon the moisture supply, so that one side of a mountain may exhibit the arid transition while the opposite slope at the same elevation bears a typical example of the Canadian. After all altitude as a factor in zonation as well as in the species content is mainly a matter of moisture controls with moderate differences of temperature apparently of secondary importance. The success of the Canadian forest is due largely to its sufficient rainfall and its adequate length of growing season. It is the zone of most efficient precipitation. Higher up the slope the snowfall is heavier, but the period of physiological drouth, i.e., of frost-bound soil, is longer.

The lodgepole pine is common throughout the Bitter Root Mountains, and as elsewhere within its range forms the typical pure stands for which it is famed. On the summit of Wood's Creek Pass, around Big Sand Lake and Elk Summit

Sub-Alpine or Hudsonian Forest—Fir and Spruce.

and along the Lolo Trail from Indian Grave to Lolo Pass, it is especially evident. The dense thicket formation so common in this species, is here and there seen but the prevailing condition is a sparse stand apparently due to the intensity and frequency of the fires, which have swept much of this area. leaving insufficient seed for a full restocking of the ground. Old stands of lodgepole which have come to maturity thin out allowing other species to enter, and a mixed forest is often the result. Along the upper Rock Creek trail some unusually fine specimens of lodgepole were observed. These had a diameter of about 20 inches with a height of over 100 feet and 60-70 feet clear. So unusual was this sight that the identity of the species was doubted until closer inspection verified it. The Lolo Trail for miles winds through an open stand of old lodgepole still practically pure and of unusually good form. The dominant undergrowth of this stand is the bear grass, which prevails often to the exclusion of other species. In the younger stages of the lodgepole forest, where not too dense, the low red huckleberry is an almost constant companion. Certain facts, which cannot be recounted here, point to moisture

(Continued on Page 95)

MOVING SLOWLY OUT OF PORT

The mountains are like big ships looming in the haze,
Heavy laden with queer stuffs of old dreams unfulfilled,
Manned by crews invincible, of old, majestic days,
Moving slowly out of port along accustomed ways.

MARY BRENNAN CLAPP.

Get the Other Fellow's Viewpoint.

HUMAN RELATIONS IN FOREST SERVICE WORK

By FRED MORRELL

Unless one plans to be a hermit he must at all times take into consideration the question of his relations with other men. Any plans that he makes for success would, if they did not recognize the human relations factor, leave out a most important consideration. If one plans to follow a profession or business his ability to make and maintain proper personal contacts becomes perhaps the most important element in his success or failure.

The profession of Forestry unless practiced on one's own land is the selling of service. Whether it be sold at a specified sum per month, as an employe of the public, or as a consulting forester, at so much for the job, it is still a question of giving satisfactory service. The better the material service rendered, the less necessary it is that his personal contacts be highly satisfactory in order to attain a certain degree of success. But the one does not operate to the exclusion of the other. High quality of material service and excellency in human contacts are both essential to a large measure of success.

The above observations are so obvious as to be entirely trite. And yet many ambitious men burn the midnight oil in preparing themselves to give the material service, and strive diligently to give it when they come into professional work, who seemingly give little thought to the other important element. The editor of the Kaimin has asked that I write something on the subject of human relations in the Forest Service. Human relations in the Forest Service are not essentially different from those in other forms of public service. So much has been written on the broad topic of human contacts by men who have made exhaustive study of the subject that it would be a waste of space for a layman to attempt anything in the way of a general contribution to it. The writer will try, therefore, only to point out some of the necessities for high attainments in this direction on the part of those who want to succeed in public Service.

In a long experience as an administrative and personnel officer, I have seen men fail for a great variety of reasons. For lack of technical knowledge, lack of courage, of industry, of honesty, and for other causes. But more than for any other one thing they have failed through inability or unwillingness to make and maintain agreeable raltions with their fellow workers or the public. We say that men must be loyal, they must be teachable, they must have tact, they must be considerate of others, they must be fair. Men universally recognize that these qualities are necessary. Almost universally do they believe they possess them in high degree. Yet many of them do not.

When a man comes in to the Forest Service he casts his lot in a big organization. Any organization must have policies, methods and procedure that are to a large extent uniform. Without that would be chaos. Many men make the mistake of thinking that limited freedom of action exists only in the organization with which they are connected. They imagine that somewhere else they could do as they pleased when they did not agree with the policies laid down. Unanimity of purpose and team-play are essential to any good organization. As much room for personal preference is given in the Forest Service as in any other well-managed public or private agency. And even in personal business, I doubt that much greater freedom prevails. The business man has after all, to do not what he would like but what will please his customers and if he isn't able to do that he is going to fail just as surely as he will if he is unable to meet organization requirements. Customers' demands may often be more onerous than are those of an organization.

And so the first thing I would say to men coming into the Forest Service is that you must make up your minds to work under policies and procedure laid down. If you don't

Alpine Fir.

like them, get them changed if you can, but until they are changed, play the game as the rules prescribe. But have charity for and tolerance of the other fellow's views. Don't spend your time crabbing about requirements made by Congress, by the Secretary of Agriculture or your immediate superiors. Most of such crabbing is due to one kind or another of exaggerated ego. Men usually crab not because they know so much but because they know so little about the reasons for existing requirements. One can't be loyal in public service without loyalty to the organization and the men and women with whom one works. There are instances where men do good through disloyalty, but remember that they are very rare. There is the extreme individualist who just cannot adjust himself to harmonious working with other men. He may be right. Usually he is wrong. Whether right or wrong he doesn't belong in an organization and when he finds himself out of step and can't get in step, he should drop out. All trite sayings again, and yet none of us learn the lesson in them as well as we should. And some seemingly do not learn *it at all.* It is one that must be practiced in *small things as well* as large. In the hour to hour and day to day contacts—it is a continuous performance—an ever-present need—not one that comes along just once in awhile.

Many men fail through a wrong attitude toward the public whom they serve. A public officer is a public servant. He is at the same time a public manager. The dual role of manager and servant is not always an easy one to fill. One must get the clearest understanding possible of what his duties are as laid down by statute, regulation and policies. This must be his guide, because it is the expression of the public majority which engages him. Any departure from the course dictated by statute, regulation and policy, any effort to follow a course that seems to him wise, is likely to be wrong to the extent that it diverges from that prescribed as above indicated.

The public, as individuals, is constantly objecting to what the majority decide should be done, and therein lies the public officials' greatest difficulty. In the main, they must in some way be made to subscribe to the will of the majority. Persuasion, tact, firmness, and force when necessary must be used to compel them.

The exact methods to be employed in going about this task cannot be defined in a general way. They will differ with each case. But the general statement can be made that here, as in contacts with men in the organization, tolerance and charity toward the other man's views are essential. Find out what he wants, and why he wants it. Put that down on one side of a line and on the other put down what you want him to do and why. See how far apart you are. Learn his motives, and his reactions. Remember that your job isn't well done unless you get done what Service policies require and leave your user satisfied. That isn't always possible, but it is desirable. Approach your task always with dignity, humility and patience. You are supposed to be a manager of a public property. That requires that you be, first, able to manage yourself, and, second, competent to manage other men.

Ready for the Drive—State Forest Scene.

MONTANA'S TIMBERLAND TAXATION PROBLEM

By T. C. SPAULDING
Dean, School of Forestry.

The subject of timber land and cutover land taxation is so extensive and leads directly into so many of the related economic problems confronting you, it will be impracticable for me to do more than touch upon a few of its phases, and possibly to suggest some remedial measures. I believe we will agree that the present Montana law is highly unsatisfactory not only in the amount levied, but in the method, or rather lack of method, in the arbitrary discretion left to more or less irresponsible or possibly incompetent officials, in the lack of any stabilized or uniform policy and in the failure to understand the true nature of the forest property or the value of soils whose primary function is the production of timber.[*]

To equitably tax any commodity it is necessary to understand the production of that commodity and the relation of this

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[*] We are now in the midst of a state and nation wide discussion of the taxation question, particularly the taixng of natural resources, among which we must consider our present virgin timber stands. In this discussion the expression "severance tax" has been widely used. I am quite sure the use of this more or less technical term has caused confusion, since the various legislative measures and the explanation indicate a "yield tax" and not a "severance tax". A severance tax is levied as an additional tax. Louisiana has a severance tax on its timber. A yield tax, on the contrary, is not levied as an additional tax but *normally* supplants other forms of taxation, save possibly *in timber land taxation*, a nominal soil tax based on the capacity of the soil *to produce.*

production to similar forms of wealth, requiring equal protection from the State. Adam Smith, in laying down the principles of taxation since followed, has said:

> 1. "The people of a Nation should contribute towards the support of the government in direct proportion to their ability to pay"—this is, in proportion to the revenue they secure by virtue of the protection afforded by the State.
>
> 2. "The tax which each individual is bound to pay should be certain, not arbitrary"—*i. e.*, should vary only with increased or decreased service rendered the individual by the State.
>
> 3. "Every tax ought to be levied at the time or in the manner most likely to be convenient for the contributor to pay it." These maxims, among others, have received general assent as they are manifestly the common sense of taxation. Do we, or does our system of timber taxation adhere to these fundamental principles? Have we a system based upon the sound judgment recited above, modified only as far as the peculiar nature of our product requires, or have we an illogical makeshift translated from other forms of property? An analysis shows:

1. That considering Adam Smith's forest maxim, *i. e.*, owners of timber lands should pay for the protection afforded their property in accordance with the revenue that property returns—our Montana procedure, while assumedly fair, leaves the most important part of all taxation, the assessment, in the hands of an elective officer, usually without special training or experience or sometimes without other qualities. If he be able to judge tiber values we may expect an assessment approaching the marketable or actual stumpage value of the stand and consequently a tax comparable to those levied on other forms of real property. This is not unfair as long as our statutes and court decisions declare the land and the timber on it both to be realty rather than soil and crop. If, however, he is untrained in timber values, or as sometimes happens entertains a more or less unfavorable attitude toward all or certain forest owners the latitude afforded him allows excessive values and with excessive values more taxes than are warranted by the protection afforded. This is well illustrated by scanning the values placed on similar stands in different counties. The legal remedies against injustice, *i. e.*, an appeal to the State Board of Equalization sometimes grants relief, usually not. The new tax commission has yet to establish its worth.

2. "Taxes should be certain and not arbitrary."

Here Montana departs sadly. In the first place values are left to the judgment of the assessor. The law provides a 100% valuation. What is full worth? How is it to be derived? What factors enter into its make-up? The law provides no standard, fixes no procedure. No two counties follow the same method, hardly any two successive assessors in the same county. This uncertainty, intangibility, appears whenever any phase is left to

A Mountain Gem.

the judgment of one man and will continue until a rigorous and standardized method of computation of cutover land and timber values is adopted.

3. "Taxes should be levied at the time and in the manner most convenient for the contributor."

Not a timber land owner, hardly a stump land owner but has heard the necessary and oft repeated demand "Conserve timber, save the reproduction, plant the burns and cutover lands, protect these from fire. Grow a second crop." There is nothing unreasonable in these widespread demands, fostered wisely by both Federal and State Forest agencies—yet neither are practicable owing to the laws prohibition of an adherence to Adam Smith's third maxim. Holding a stand for the use of the next generation—say 20 years from now, means—

1. You may lose your timber by fire.
2. You may secure a sufficient increase in value to pay your protection expenses.
3. You will pay taxes year after year on land and timber despite the fact that no revenue is accruing you from the property nor will it accrue until the crop is harvested.

The average *tax* per M feet in western Montana is about *4 cents. The average* timber land owners pays about 8% for

money. His taxes compounded annually, have amounted to $1.85 per M in this short period of 20 years, this assuming no increase in either assessed value or levy. He leaves a thousand feet of timber per acre as seed trees. It will, assuming he and his posterity retain the land, take 100 years say, to ripen this second crop. He will, under our law and its enforcement pay 4 cents taxes and more per year on those seed trees, pay about 10 cents per acre per year additional as a land tax, and when the young stuff becomes large enough to measure in terms of marketable products pay full value taxes annually. If by that time we have reduced the fire hazard he should be able to borrow 5% money. The 14 cents alone has jumped to $364.00 per acre.

On one hand we find one branch of government, fostered by public sentiment demanding both the reforestation of burns and stump land and the maintenance of the present stand, and on the other hand another political subdivision precluding compliance by an ascending scale of taxes. Governor Dixon, of Montana, recently said:

> "Under our constitutional mandate the present system of taxing our diminishing timber supply is not only an economic crime but threatens the future welfare of the state. It enforces the cutting of our timber supply for the future ahead of its natural time, by its present owners in order to avoid absolute confiscation.
>
> "Timber, like minerals, should contribute an extra heavy tax when severed from the soil. It is my belief that Montana, in self-defense of its own future development, and in order to conserve its valuable timber resources, should change its present unscientific method of taxing timber, providing a moderate tax on the land and a heavy toll from the timber itself at the time it is harvested.
>
> "This can only be accomplished by an amendment exempting standing timber from the recurrent annual taxes on the same identical forest crop and giving the next legislature power to adjust the severance tax* in accordance with the unanimous judgment of all political economists and forestry officials."

Our operative plan is now based on constitutional provisions. Any permanent relief must come through a change in our constitution rather than a lowering of assessed values, advocated by some. Lowering assessed values is an untrustworthy, temporary expedient open to all the objections of uncertainty and arbitrariness. It does not grant permanence to the industry or guarantee of continuity of policy. You want, and the public needs, a fixed and definite state control, guided by laws based upon the peculiarities of your industry, allowing you full play to use or conserve your holdings, regenerate your cutover lands and forest areas and, while redeeming your public duty, make a reasonable return on the captial you have invested.

To accomplish this, and I speak from the experience of other states and nations, not from theory, your timberland taxation code must provide for:

**Note*—I feel sure the Governor means a yield tax.

Large Enough for the Tax—Too Small for the Axe.

(a) The recognition of the fact that timber is a crop, and as such must be divorced from the land. The only element of difference between wheat and timber is the longer period required to bring it to marketable condition. A tree is a plant grown from the soil. The application of the present law does not tax the farmer's growing crop. There is no more reason for taxing yours. If the stand is large enough to cruise—say 10 inches on the stump—you are taxed—yet it may not be of saw size or marketable size, for 20 years or more.

(b) The classification of your land as either forest or agricultural. Practically any land that can be put to farm purposes will return a higher soil rental than in the growth of timber. Lands permanently devoted to timber growth must be those producing their highest financial return in that form of use. This classification, applicable, largely to your stump lands should be provided by the State, upon application of the owner of the property.

(c) The imposition of a soil or ground tax. Theoretically, farm lands are taxed in accordance with their ability to produce. Forest lands should be assessed in the same manner—not on a mythical grazing or pasturage value but in direct proportion to that land's ability to grow timber. The poorer the land for the production of timber—the lower the value. This nominal ground tax is advisable since the state affords continuous protection while the land is growing its crop.

(d) Freedom from all forms of taxation except the soil tax until you receive financial returns from your investment.

(e) A yield tax to be paid when your timber is cut and marketed. This *makes* payment easy as you have realized on

(Continued on Page 93)

money. His taxes compounded annually, have amounted to $1.85 per M in this short period of 20 years, this assuming no increase in either assessed value or levy. He leaves a thousand feet of timber per acre as seed trees. It will, assuming he and his posterity retain the land, take 100 years say, to ripen this second crop. He will, under our law and its enforcement pay 4 cents taxes and more per year on those seed trees, pay about 10 cents per acre per year additional as a land tax, and when the young stuff becomes large enough to measure in terms of marketable products pay full value taxes annually. If by that time we have reduced the fire hazard he should be able to borrow 5% money. The 14 cents alone has jumped to $364.00 per acre.

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> "Under our constitutional mandate the present system of taxing our diminishing timber supply is not only an economic crime but threatens the future welfare of the state. It enforces the cutting of our timber supply for the future ahead of its natural time, by its present owners in order to avoid absolute confiscation.
>
> "Timber, like minerals, should contribute an extra heavy tax when severed from the soil. It is my belief that Montana, in self-defense of its own future development, and in order to conserve its valuable timber resources, should change its present unscientific method of taxing timber, providing a moderate tax on the land and a heavy toll from the timber itself at the time it is harvested.
>
> "This can only be accomplished by an amendment exempting standing timber from the recurrent annual taxes on the same identical forest crop and giving the next legislature power to adjust the severance tax* in accordance with the unanimous judgment of all political economists and forestry officials."

Our operative plan is now based on constitutional provisions. Any permanent relief must come through a change in our constitution rather than a lowering of assessed values, advocated by some. Lowering assessed values is an untrustworthy, temporary expedient open to all the objections of uncertainty and arbitrariness. It does not grant permanence to the industry or guarantee of continuity of policy. You want, and the public needs, a fixed and definite state control, guided by laws based upon the peculiarities of your industry, allowing you full play to use or conserve your holdings, regenerate your cutover lands and forest areas and, while redeeming your public duty, make a reasonable return on the captial you have invested.

To accomplish this, and I speak from the experience of other states and nations, not from theory, your timberland taxation code must provide for:

**Note*—I feel sure the Governor means a yield tax.

Large Enough for the Tax—Too Small for the Axe.

(a) The recognition of the fact that timber is a crop, and as such must be divorced from the land. The only element of difference between wheat and timber is the longer period required to bring it to marketable condition. A tree is a plant grown from the soil. The application of the present law does not tax the farmer's growing crop. There is no more reason for taxing yours. If the stand is large enough to cruise—say 10 inches on the stump—you are taxed—yet it may not be of saw size or marketable size, for 20 years or more.

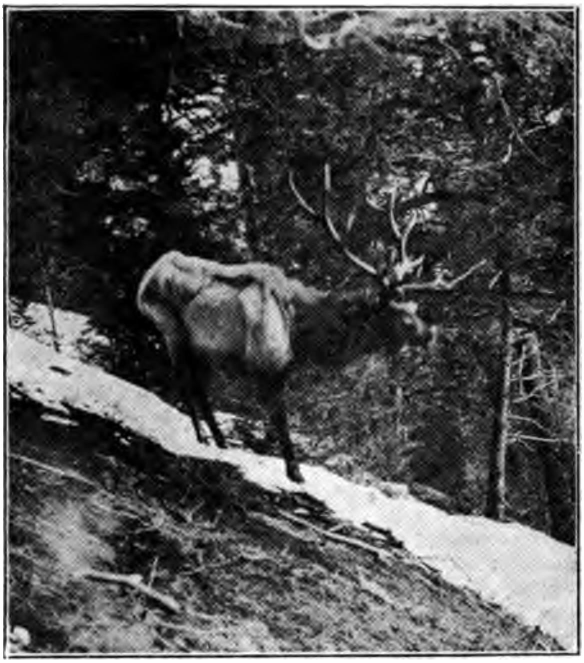
(b) The classification of your land as either forest or agricultural. Practically any land that can be put to farm purposes will return a higher soil rental than in the growth of timber. Lands permanently devoted to timber growth must be those producing their highest financial return in that form of use. This classification, applicable, largely to your stump lands should be provided by the State, upon application of the owner of the property.

(c) The imposition of a soil or ground tax. Theoretically, farm lands are taxed in accordance with their ability to produce. Forest lands should be assessed in the same manner—not on a mythical grazing or pasturage value but in direct proportion to that land's ability to grow timber. The poorer the land for the production of timber—the lower the value. This nominal ground tax is advisable since the state affords continuous protection while the land is growing its crop.

(d) Freedom from all forms of taxation except the soil tax until you receive financial returns from your investment.

(e) A yield tax to be paid when your timber is cut and marketed. This *makes* payment easy as you have realized on

(Continued on Page 93)

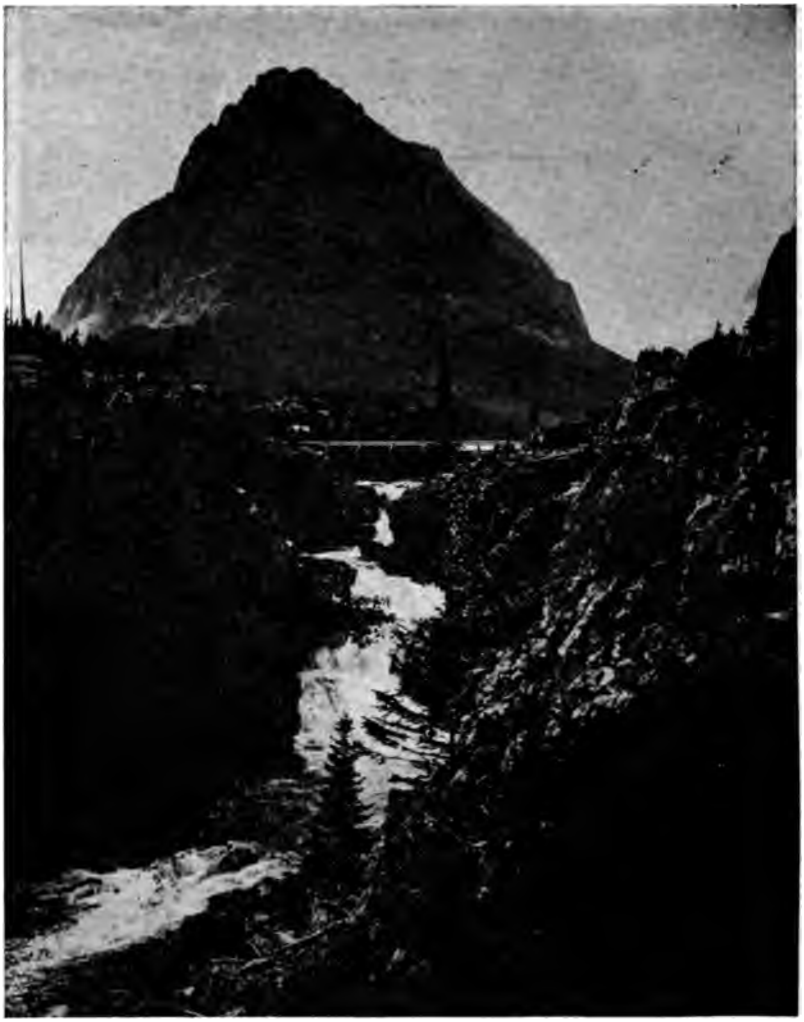


A Lone Survivor.

THE TROPHY

A giant elk, with swollen growing horns,
Lay during summer noons in icy ooze of alpine lakes,
Or stood in shady thickets where the flies were few.
As days grew shorter, and the horns
Began to harden, he rubbed the velvet from them,
Scarring the limber pine trees with the thrustings
And fierce lungings at a half-dreamed foe.
When tamaracks turned golden, and the blue-jays thronged
In open parks where berries of the ash were red
The tines were ivory white, and the elk's shrill call
High noted, full throated,
Sent echoes down the rocky gorges,
The battle call—the mating call—all one,
That wild far-reaching bugle note.
But now—he's just a trophy—on a wall—
Artificial eyes—and a brass plaque—
"*Presented* by Brother James Wolfe—1921."

JACK FROLICHER.



SELLING FORESTRY

By ARTHUR L. STONE

Tabulation of civil-service examinations in Greater New York reveals that a metropolitan policeman must know five thousand things. Also, he must be able to apply this encyclopedic knowledge and to function quickly in the application. The forester must know more than a New York policeman. To *attempt to* enumerate all the things he has to know *would make an* extended catalogue and it is likely that it would not be complete—for there is always something new for him to master.

Axman, botanist, veterinarian, weather observer, marksman, packer, sprinter, farrier, lecturer, cook, smoke-eater, general, private—all these he is by the very nature of his calling and because of the absolute isolation which his profession often imposes upon him. If he gets into trouble, he has to get himself out; he cannot summon any reserves by blowing a whistle. The walls which hem in the canyon along which his beat runs are, it is true, skyscrapers, as are those which bound the vision of the copper, but the forester's skyscrapers were not builded by human hands. The mountains are his inclosing walls.

If the forester is to succeed in his profession, he must equip himself for the performance of yet another duty than those which are included in the list usually recognized as constituting the range of his work. He must be a good salesman—the salesman of an idea.

Upon the salesmanhsip of those in the forest service—which is the public's service—depends to a very great extent the success of that service in so far as its central idea, conservation, is concerned. This is particularly true of the man in the field; he is the contact point between the public and the service which he represents; somtimes, too, it is a public unwilling to be convinced and then the task of selling becomes all the more difficult.

No public service—forestry, education, journalism—can afford to disregard public opinion. It is true there is often a disposition to discredit this thing we call public opinion—to consider it as a myth—but it is a powerful force and there is no service, no organization, in the class mentioned which is not benefited by a friendly public opinion and which is not injured by one which is hostile.

"That great compound of folly, weakness, prejudice, right feeling, wrong feeling, obstinacy and newspaper paragraphs"—so did Sir Robert Peel in 1820 mention public opinion. So, too, do many of us in this century profess to regard it. But it is something to be reckoned with; it is a force for good or evil which we cannot ignore.

In the beginnings of practical forestry in the West, it required the actual demonstration of the forestry idea by the men in the field to overcome rather a firmly established hostility to the new plan. But it was the field men who put across the sale; their wise and conscientious execution of the policy which had been planned by their superiors accomplished what could not have been done by an army of lecturers or by mountains of printed argument.

These pioneers in the service sold to the western public the idea of conservation. It appears to be a reasonable state-

Stillwater Lake.

ment, that the people of the West believe in the doctrine of conservation and have faith in the efforts which are being put forth by the forester to apply that doctrine.

But conditions are constantly changing; new problems present themselves with regularity and persistence that are discouraging; new forest foes; new economic questions. So there can be no rest; there can be no abatement of the salesmanship campaign. The public must be served but first it must be convinced.

In no other way can the forester so well establish a friendly relationship with the public as by the thorough and faithful performance of his duty. To his particular local public this will in itself carry conviction almost always. It goes without saying that this salesmanship involves as a fundamental a belief on the part of the forester—a belief in the forestry idea which amounts in its sincerity to a religion. This is an element of all successful salesmanship.

The man in the field has the advantage over his superior officer, back at headquarters, in that he is in personal contact with his public. He can adapt his course to meet local conditions without deviating in any way from the general policy which has been outlined for his guidance. It is not difficult for him to demonstrate to nearby farmers, to stockmen, to those who travel through his range, to the lumberman cutting under permit—to any and to all of the varied interests represented, that he and the organization which he

Lake Josephine and Garden Wall.

represents desire to render the most effective and helpful service possible.

He can rouse interest in conservation which will make of every man in his field a willing co-operator in fire-prevention and in fire-fighting. He can secure this co-operation from the women, too, and from the youngsters. They are all helpful allies in one phase or another of his varied work.

He can supplement the stereotype placards and posters with others which he designs to meet some local problem or to solve some local question. He can give helpful advice and assistance to a farmer who wants poles of firewood. He can render almost unnumbered services to his public which will line up those men and women solidly behind him and the idea for which he stands.

These opportunities are daily presented; they vary with location; they come in new form every season. Alertness to recognize these opportunities and the ability to take advantage of them combine to insure high-class salesmanship of the Great Idea of forestry. The local newspaper office, the schoolhouses, the country store, the community clubs which are becoming so important a part of rural life even in remote places—all these offer the chance which the earnest salesman wants. If he is wide awake he will not be slow to seize them whenever and wherever they occur.

This is a meager outline but about it the forester will be able to shape his own campaign of education and enlightenment. In the forest regions of Montana such a campaign has been well arranged for the 1925 Forest Week. The Great Idea is carried wherever voice can reach, wherever a newspaper can deliver the message, wherever earnest pleaders and competent instructors in fire prevention can find a hearing.

No suggestion even is offered here as to the subject matter of formal and informal talks in a campaign of this kind, except that it must be as graphic as possible and must have the ring of truth and sincerity. The forester's technical knowledge and his familiarity with his community will supply the rest. One local illustration in this connection is worth volumes of theory. One plain talk often reaches farther than a long programme of oratory.

Convince the individuals and the groups—public opinion will be formed. The right sort of public relationship will be established. This is as essential to good forestry work as is an axe.

When I cash in my checks, and that thing preachers call a soul
Goes hunting in the great beyond for some new resting place,
I want to be a chipmunk, and I think I'll have my hole
Near the cabin of some ranger who has a friendly face;
Some man who knows a chipmunk's every need,
Who has some woolen clothes that I can ravel for my nest,
Who leaves bread and rice to furnish me with feed,
Who doesn't care a little bit when I disturb his rest
As I frolic with my playmates in an early game of tag
All through the room—beneath—upon his bed,
And I know my friendly antics will not make the hours drag;
Yes, I want to be a chipmunk—when I'm dead!

JOHN C. FROHLICHER.

"THE GOLDEN WEST"
COPYRIGYTED BY R H MKAY
of
MKAY ART CO.

GATHERING THE BITTER ROOT

In scarlet shirt and gray sombrero,
Driving his lean-limbed broncho team,
Black-Wind turned to the girl beside him,
With smiles as sweet as a girl might dream.

Emerald-basqued and purple-kerchiefed,
Aspen-Leaf, tremulous, leaned to his arm.
There in the wagon, rickety, rattling,
Life spread the spell of its ancient charm.

Comrades they were, and more than lovers,
Simple, unlettered, but feeling for truth,
From some great Spirit, potent, all-knowing,
Buying a partnership with their youth.

Full of the sweet exulting of springtime,
Black-Wind and Aspen-Leaf answered the call,
Guessing its purpose, braving its hazards,
Asking and giving not less than all.

MARY BRENNAN CLAPP.

EDITORIAL

IN APPRECIATION

"After all this is a friendly old world in which we live." This statement is substantiated by the generosity of our contributors, who have given a vast amount of time and labor to the preparation of the articles herein published. Every contributor is in some way identified with our Forestry School, either as special lecturers from the United States Forest Service or as faculty members and students.

We thank them for their kind and generous cooperation which has made possible the realization of our ambition—A Strictly Montana Kaimin.—*The Editors.*

* * *

THE BISON RANGE

This issue of the Kaimin contains a short history of the Montana Bison range. This place is one of the easily accessible points of interest which may be visited from Missoula. Mr. Rose's work is being ovserved with considerable interest. It marks a progressive step in game conservation and the results, thus far, are more than an indication that big game raising on forest lands might well become a very profitable source of revenue.

* * *

INACCURACY

Digging your own grave is most certainly a grewsome assignment and one which very few men would undertake willingly. Should a man voluntarily set about this task, his sanity would be questioned, yet a great many fairly brilliant men prepare the final resting place for their professional aspirations with appalling carelessness. The chief tool used for excavating is inaccuracy.

* * *

The winning lies not in the holding of a good hand, but in *the ability* to play a poor hand well.—"Parson" Sandvig.

COMMENT

In every generation a few men are born whose hearts beat a little faster, whose minds are a trifle clearer, whose ideals are slightly higher, and whose souls desire a greater freedom, than the rest. These men are seldom noticed in their day and, perhaps, their final rewards are unmarked graves at the ends of dimly blazed trails.

When these dim trails have been widened into thoroughfares and the footprints of the first travelers have been trodden deep into the dust, they who blazed the trails may be remembered and hailed as pioneers. Whether remembered or forgotten matters not. Their works are eternal and will benefit the living forever.

The old frontiers have passed as we once knew them, with their pathless wilderness but we still have a vast unknown, marked by the outposts of knowledge, beyond which the pioneers of today may blaze new trails.

No science offers a richer field for exploration than forestry and no scientist represents the true pioneer so perfectly as does the forester. The blood of the pioneer truly flows in his veins. The feel of newly blazed trails beneath his feet is meat to his hungry soul. The odors of the forest are the sweetest of incense to his nostrils. He toils not for fame or gold, but to create and care for a forest which is his tribute to his God and his bequest to posterity.

* * *

We all have lots of troubles, but most of them never happen.—*"Chief" Myers.*

* * *

There is a "density" which shapes our ends.—*"Gen." Lee.*

Baby Elk.

Antelope Herd.

THE MONTANA NATIONAL BISON RANGE

By FRANK H. ROSE

Warden.

The Montana National Bison Range, located on the Northern Pacific Railway between Ravalli and Dixon about forty miles west of Missoula, comprises an area of 18,521 acres or 29 square miles. For varieties of rich grasses, pure water, picturesque interior and picturesque surroundings the Bison Range is believed to be absolutely beyond compare. This range was purchased from the Indians sixteen years ago. It was fenced by the Forest Service and is under the administration of the Biological Survey of the United States Department of Agriculture. A 23 mile fence 77 inches high of No. 9 woven wire, with one barb wire below and three above, surrounds the range. Ten thousand 10-inch cedar posts are used in this outside fence. Elk, deer and mountain sheep occasionally jump this fence, but for the majority of the animals this height has proven satisfactory. These posts have recently been numbered and a record is kept of replacements, which eventually will give a good record of the life of posts under our conditions. At present there are no interior fences, the whole range being in one big pasture.

From the original small beginnings sixteen years ago there are at present 490 buffalo, 28 mountain sheep, 8 antelope, 100 deer and over 500 elk on the range, which is considered 22 per cent overstocked. Spring feeding of buffalo from April 1st to July 30th is practiced to prevent overgrazing of the forage during its principal growing season, in this way balancing

An Elk Herd.

the excessive numbers and maintaining the range even while too heavily stocked. Four hundred and sixty buffalo are now being fed alfalfa hay purchased locally.

The original native grasses, which have disappeared from so many outside ranges, are still abundant on the Bison Range and will be maintained. This, with the exceptional winter climate, gives this range a higher capacity than most Montana ranges now used for domestic stock. With a variety of game animals of widely different feeding habits, better distribution on the range is possible than is ordinarily secured on ranges used exclusively by one class of domestic stock.

Three pens of about twenty acres each have been built for feeding the buffalo, and a heavy plank corral 9 feet high with a loading and separating chute have been constructed for handling the buffalo and eventually the elk. The improvement most urgently needed is interior fences separating the range into a number of pastures. These would permit more ready handling, rotated grazing, segregation and other features of a range management plan. Feeding part of the buffalo and part of the elk would give a somewhat more uniform reduction over the range as a whole, but it is not possible at present without interior fences to get the elk into the feeding pens.

It is the intention to reduce the game herds to the normal capacity of the range. This will require the removal of about 250 head representing the 22 per cent now overstocked, and in addition the annual removal of a number equal to that year's calf crop, at present about 250 head a year. Two hundred and twenty buffalo were disposed of last year, part as live animals and part as dressed meat. The sale of live animals, dressed meat, buffalo robes and heads for mounting will return to the Government the money spent in administration of the range and more.

Much of the work on the Bison Range is more or less experimental, as little has previously been done toward placing wild herds under administration and just how a buffalo or elk will act under a given set of conditions is more or less problematical. Opportunity is offered on the Bison Range for many interesting observations on the needs and management of wild life, especially big game. Special studies will be made on carrying capacities, forage requirements, game palatability tables, etc., as well as observations on breeding and feeding habits and management methods applicable on fenced and open ranges. The most urgent problem on the Bison Range is putting under management the game which has heretofore run in a more or less wild state. This is in order that the necessary reductions may be carried out in such a way as to maintain properly balanced herds of fine type animals, with breeding and exhibit stock always available to states, parks and individuals for stock depleted ranges or other purposes.

The Montana National Bison Range is also a bird refuge, and many ducks, five varieties of grouse and other game and non-game birds nest and find refuge here. Predatory animals and birds, including magpies, are kept under control by systematic trapping, hunting and fencing.

On account of the nature of some of the animals within the enclosure and the work to be accomplished on the limited funds available, the public is generally not admitted to the

Mountain Sheep.

range. Exception is made during the spring feeding while the buffalo are penned and an attendant always at hand. It is hoped eventually to develop the range to care for all who wish to see considerable numbers of big game animals grazing under natural conditions.

Ptarmigan in Winter Plumage.

IN SEASON

If daffodils and roses were to blossom in the snow,
Or sunrise touch the hill-tops when I looked to see the moon,
It wouldn't be more lovely than a lovely thing I know,
That Christmas candles grow upon horse-chestnut trees in June.

MARY BRENNAN CLAPP.

LAND CLASSIFICATION AS PART OF THE NATIONAL FOREST WORK IN MONTANA AND NORTH IDAHO

By M. H. WOLFF
Assistant District Forester.

During the period prior to 1906, there was no provision through which anyone could acquire, through homesteading, any National Forest tract whose chief value was for the raising of farm crops. Homestead entries made only before the withdrawal of the lands for National Forest purposes could be maintained so long as the entryman complied with the requirements of the Homestead Law.

Within the gross area of the National Forests, there was a considerable acreage of land which was chiefly valuable for agriculture. This mainly included meadows lying practically or entirely on the river bottoms or lower benches, and areas of brush land or willow and alder bottoms, lying at the lower altitudes where soil, climatic, and other growing conditions were favorable. In laying out Forest boundaries at the time they were withdrawn, it was, of course, not possible to exclude scattered tracts such as these. While the total area of such tracts was large, it comprised an extremely small portion of the total Forest area.

The use of such lands for agricultural purposes could, of course, be regularized and permitted through special-use permits under the regulations of the Secretary, through the authority granted him under the Act of 1897. But any system of leasing agricultural lands as a general policy has *always been considered* unsound economically and sociologically.

Winter Occupations.

Consequently there was enacted on June 11, 1906, what is known as the Forest Homestead Act. With certain differences from previous homestead legislation not greatly affecting the major object, this act permitted the homesteading of National Forest areas, which could properly be applied to such use. Of the differences, the most pertinent one was that whereas the original homestead act permitted the entry of any public lands not otherwise reserved or withdrawn, or under a prior entry, the Forest Homestead Act limited the right to make entries only to lands which had been examined and determined by the Secretary of Agriculture to be *"chiefly valuable for agriculture, and which in his opinion may be occupied for agricultural purposes without injury to the Forest reserve, and which are not needed for public purposes, . . ."* At first the procedure under this act amounted to examining lands as they were applied for by those interested, and then either approving or denying such applications, depending upon the findings. Under this pprocedure a great many homestead tracts were thrown open to settlement, and subsequently passed into the hands of people who developed them into farms.

The demand for lands under this act in time became so great, the pending applications became so numerous, and the volume of work involved in the Department of Agriculture so large that there began to be sought a more systematic way of disposing of these areas than to examine tracts piecemeal upon individual application. Consequently there was enacted on August 10, 1912, in connection with the Agricultural Appropriation Act, a Federal statute which has been the basis of so-called Land Classification work that has been carried on since that time. This provision read in part that "*The Secretary of Agriculture is hereby directed and required to select, classify and segregate as soon as practicable all lands within the boundaries of the National Forests that may be opened to settlement and entry under the homestead laws applicable to the National Forests,* . . ." Congress also appropriated certain moneys to carry the cost of this additional work and subsequently provided similar funds from year to year.

The great job of Land Classification was undertaken by the Forest Service with close co-operation with the Bureau of Soils. The first step in the classification was to determine, after field examination, those areas of the National Forests which unquestionably were not chiefly valuable for agriculture as against the major purposes for which they had been withdrawn as National Forests,—timber production, watershed protection, and purposes incidental to these as defined in the provisions of the Act of June 11, 1906, above quoted. This work was called extensive classification. Because of the very nature of the Forest areas, the lands definitely classified as permanent Forest lands comprised all but a very small portion.

The areas which, through extensive classification, were determined to have possibilities within the scope of the Act of June 11, 1906, were left for intensive classification. In this work close contact by Forest officers was maintained with representatives of the Bureau of Soils, and most of the specific jobs were, in the field, handled by representatives of both Bureaus. Naturally, out of the acreage left for intensive classification, not all was finally classified as chiefly valuable for agriculture. The areas which finally were determined as chiefly valuable for agriculture were, as soon as possible thereafter, listed with the Department of the Interior for opening to settlement.

The field examinations and the subsequent analyses of findings were handled by men in the Forest Service who were specially selected for their experience, training, and ability in judging values of lands for farming purposes. Their very detailed and comprehensive reports were passed upon and approved by the Secretary of Agriculture before the findings were made effective. The general principles under which the examiners worked, which helped them arrive at a clear solution to many and various knotty problems, were developed during the course of the work by responsible higher officials in the two Bureaus, and were approved by the Secretary of Agriculture, himself.

While practically all the land classification work is done and all lands susceptible to farming have been opened up and have been acquired by settlers, there still remains a continuing amount of land classification work to be carried on. This is the result of, (1) changes in physical character of forestry values on specific tracts, (2) recognition of possible errors in existing classification, or (3) the need of considering agricultural possibilities of lands whose addition to the Forests is contemplated under the various acquisition laws enacted in the last few years.

As to the first of these, it was found at the time of the classification that in some relatively few cases permanent classification had to be deferred. A temporary classification was all that could be made at the time. For example, lands which had on them a heavy stand of timber, but which contained soils of depth and character susceptible to agriculture and were situated where climatic conditions were favorable, had some value for agriculture. But as a general rule, this value did not equal or exceed the value of the land for the timber on it. The experience of the Government in opening to settlement lands of this class had demonstrated that economically the land could not be considered chiefly valuable for agriculture. Such lands, after title to them was obtained, were almost wholly used, not for the raising of agricultural crops, but for the holding of timber. Generally, areas of this character had been drawn into the ownership of large timber holding individuals or organizations who purchased them from homesteaders and held them in a forested state until the timber on them was removed. There was therefore, no stimulus or constant effort toward bringing such lands under cultivation and the making of farm homes on them, and thus the underlying purpose of the homestead law was defeated. After the cutting of the timber, lands of this character were put on the market by the owners and sold to agricultural homeseekers, not infrequently under conditions and terms which rendered success difficult.

The Government investigators came to the conclusion that

(Continued on Page 98)

A Good Mountain Lion.

OCTOBER IN DEEP CREEK

All along Deep Creek the tamaracks grow.
Yellow aspens shiver on the bank below.
The grapes are purple and the rose-haws red,
And gray sand shows in the river-bed.

All along Deep Creek in the harvest glow,
The witch-trees wait in a crooked row,
Yellow arms stretched to the autumn sky,
Black veils waving as the wind goes by.

A white half-moon winks over the hill,
The sun's slant shifts and the winds turn chill.
The witch-trees glimmer like ghosts of light,
Pale ghosts gathering for All Hallo's night.

I wish I could stand in the empty house
That faces the narrows where a ferry used to cross,
And listen to the gossip of forgotten years,
With a woman's heart and a witch's ears!

MARY BRENNAN CLAPP.

N. B.—Deep Creek empties into the Clark Fork about twelve miles northwest of Missoula. *The tamaracks*, yellow in the autumn, are draped with drooping *of the black, hairy* ***Alectoria fremontii***.—M. B. C.

AROUND THE CAMP FIRE

FORESTRY CLUB

By REMLEY E. MYERS.

The old timer, wandering into a present-day meeting of the Forestry Club, would find that its activities have not changed in the least.

The club has grown from a membership of 25 to over 100 since its birth in 1914, which occurred with the starting of the present Forestry school.

In the fall of 1914 when the school was organized with about 12 studetns and a faculty composed of Dorr Skeels and James Bonner, a meeting was held at the home of Dorr Skeels and the club was organized. Harry Ade, president; Harold (Peg) Lansing, vice-president; Fred Haines, secretary, and Kenneth Wolfe, treasurer, were the first officers of the club. During the first year meetings were held at the homes of Skeels and Bonner.

In the spring the first Foresters' Ball was held in the old gymnasium. The ball was the continuance of the old Ranger school dance which the rangers used to hold for themselves during the late winter.

Most of the men who came to the Ranger school were married, and a dance was held that was different from other college affairs. "Woods" clothes were then, as now, the rule and later when the club was established this custom was continued and enlarged to include all University students. The first Foresters' Ball put on by the club was held February 15, 1915. No admission was charged, but holdup men extracted a dollar from each man on the floor after a gun-fight between sheriffs' posses and the stick-up men. Boughs were used as decorations, which custom still prevails.

The annual publication of the Forestry Kaimin is also a tradition of the club established by the first club members. The first edition, dated March 11, 1915, was one of the achievements of that first year of existence. Harry Ade was editor and Harold Lansing assistant editor.

Since then the club has continued to publish this magazine devoted to promotion of forestry ideals and to advertise the school throughout the country.

The significant part of the history of the club is not in the growth of its membership, for that is but expansion with the growth of the entire University, but that the policies are now the same as when first organized. Policies remain the same today as then. An account of a meeting held at the home of Dr. Bonner in 1915 is practically the same program that is followed at meetings the present year.

In 1921 a constitution was adopted which all members sign when they join the club. It is a written expression of the policy of the club as conceived by the founders. Its achievements are many but no achievements can overshadow the work of those men who had an idea and put it into the Forestry club.

THE DRUIDS

About two years ago Ralph Fields, '25 F, and a member of the faculty of the School of Forestry, chanced to be discussing the various problems presented by the Forest Club. We knew it fully met the needs of the undergraduate student body in a social, a recreational and an educational sense, and in a large measure, provided for a unit action of the whole body of Forestry students, should such action be advisable. It was felt that its size and the communities of interests present even within this close knit group, did not provide for the maintenance of a sustained school spirit and mutual contact after graduation,—something woefully lacking in all branches of the newer, traditionless Western colleges and universities. *Esprit de corps,*—the ideals and ethics of the profession, an abiding faith in their University, and with these, confidence in themselves and the things they represent must come from other sources.

How could these be seized upon and implanted in the heart of Montana's contribution to the profession? Not in the individual, or alone *in the* classroom or yet in the club, but best *by making these things* the soul of a group of well-tried upper classmen,—who themselves have shown a spirit that best can be expressed as the soul of the profession. And this was done.

Need not to mention Colville, Bitney, Rowland, Brown and half a dozen others in their work of organization, for all of the original group gave heart and soul to the task of translating those intangible ideals into a code and a ritual and a spirit of service,—yes, even a creed, that those who come after may ever carry onward the vision of these few men.

Only time can tell the real worth of the Druids. May it live in and with the college. May it rise above the sordidness of greed and debasement. May it be worthy of the best in men. May its principles and tenets hold those of tomorrow as it grasps those of today. Then will it have proven itself and then will its altar fires forever live in the green wood.

The Old Shack.

THE DUAL MEET

The Longhorns versus The Shorthorns

By SAM F. HARRIS.

The Longhorns (regular students) registered revenge against the Shorthorns (ranger students) for the trimming which they received at the hands of the latter last year. Not only did the Shorthorns win the dual meet in 1924, but they added insult to injury by having their group picture taken and hung in the club room of the Forestry Club. Although the score was close enough to give the Longhorns little to crow about, still it spelt victory to them.

More enthusiasm and pep was exhibited at the meet this year than usual. Perhaps that picture hanging in the club room had something to do with it. Furthermore there were several of the last year rangers back in school this year.

The dual meet started off this year with a bang. "Bang" is right, for the short-course students won the rifle shoot over the Forestry Club rifle team in the Marcus Cook hall, giving them ten points to start on. The rope climbing contest was next, with an entry of six men, three on each side. The regulars took first and second. The packing contest was won by

the shorthorns, showing that practical experiencee in some lines leads over education. The short course men again showed their speed and endurance by winning the three-legged race. This brought the regulars up on their toes and the old fighting spirit began to manifest itself at last.

The back packing contest followed, with four men from each team entering the event. A fifty-pound pack was placed on the back of a man from each team. They raced the length of the gymnasium floor, placed the pack on another man's back and he in turn raced the length of the floor, and so on until the relay race was completed by each man. The regulars won this event by a few feet. The log-chopping contest was next up. Whiting, from the Kaniksu, was an easy winner in 1924. This year he went in a little more for style than speed, which cost the shorthorns ten points on the final count. The log-sawing contest was next up, with Whiting and Flodberg representing the shorthorns. Whiting realized that his grandstand play on the ax handle had cost him the chopping victory, so he decided to take no chances with the saw. They waded through a sixteen-inch log in fourteen and one-tenth seconds, beating the regulars by thirteen seconds, thanks to the Atkins saw.*

The wrestling and leg-wrestling events were very exciting. Burbank, of the regulars, won the decision in the six minutes wrestling bout with Aimisegger. Cornell, of the regulars, won from Cuff in a straight fall in forty-eight seconds. The leg-wrestling event was an elimination contest, which was won by Coburn of the regulars in two straight falls. The basketball contest, 24 to 10 in favor of the regulars, closed the events of the evening. The final points of the meet were: Regulars, 43; Shorthorns, 31.

Dean Spaulding acted as announcer; President C. H. Clapp, field judge; Dr. Schreiber, timer; and the judges were made up of officials from the district office.

Following the meet, hot lunch was served by the Forestry Club in their club room at Pinchot hall.

*Note: Atkins saw which was used was presented to the winners, by E. F. Mitchell, the C. E. Atkins Saw Company's representative from Spokane, Washington.

ANNOUNCEMENT

The engagement of Monroe DeJarnette and Miss Hazel Campbell of Seattle has been announced. The wedding will be held June 10 at Seattle, after which the couple will make their home in Sandpoint, Idaho. Miss Campbell is a student at the University of Idaho and a member of Kappa Kappa Gamma sorority.

SPRING CAMP

1925

By R. H. BITNEY.

About the time when spring fever has conquered the co-eds' wiles and the boys begin to long for the hills, the Forestry School greases its boots and starts for spring camp. Some go by car, some ride Tom's truck, but the most go by train, leaving at eight in the morning and getting in at noon if the trainmen don't pick flowers or flirt too long with the squaws. Every town along the way is given its annual treat by the boys, although it is doubtful if the towns consider it as such. Polson, where they all disembark, comes in for the lion's share, as the gang surely takes the town in. After the bunch gets corralled and all the restaurant furniture paid for, they start for camp. This is usually accomplished in one of two ways, either by boat or by auto. The boat is the best as it is cooler and more enjoyable. Camp for the last two years has been at Yellow Bay at the Biological Station of the University. Last year no guns were allowed and this was a very good thing, as the birds, animals, etc., are all protected on the tract, which is kept as close as possible in the wild state to better study the wild life there. After arrival at the station, everyone "falls to" in regular army style and the tents are put up in a jiffy, beds are laid and all are set for the program.

The camp is run on a regular schedule: classes are checked carefully, everything runs as smoothly as though they were back at the school. Last year the sawmill at Somers was visited and studied from every angle, from machinery to the finished product. Then the men went over to the tie-treating plant and watched the process. The next day the class in grazing went over to Wild Horse island and figured the carrying capacity of it. Skeels' classes in management and silviculture went over the station the next day and examined types, growth and volume. Mr. Graff of the Botany department conducted the class in ecology and had the pleasure of having the class run a transect from the edge of the lake to 3,000 feet elevation. This was enjoyed by everyone, especially Mr. Graff. Sergeant Truman of the R. O. T. C. had the pleasure of drilling the boys a few times to kind of keep them in trim. Professor Wilson of the Geology department took the class in forest geology upon the Swan range to look at the rocks and work up a good appetite. Jerry had his bunch out surveying, and Fay had his class in mensuration out in the woods on volume tables and growth studies.

But the camp is not all work. Fishing season was not open but the gang consoled themselves by listening to Chief Myers orate on the big ones he got when they were up there before. Horseshoes was a favorite sport, with many contests, and Tom Spaulding with Ralph Fields holds the coveted horseshoe championship. Every night there was a big bonfire on the beach and a fine Liars' Convention was held there, with Ananias far in the rear. The war was fought over again, with variations on who hiked the farthest and who had the least to eat. The rowboats and launch hired for the occasion were much in demand, and several "would be" marine mechanics had an opportunity of testing their ability or getting out and walking in the middle of Yellow Bay. Indoor baseball came in for a share of the boys' time, and there were some very spirited games. The night was tortured by the yowlings of some so-called "quartets" that would put any self-respecting tom-cat to shame.

Taking it all in all, though, everyone had a good time, and it is hoped that the Forestry school will get enough equipment of its own to hold one next year.

The Limit.

THE ELEVENTH ANNUAL FORESTERS' BALL

By SAM F. HARRIS.

From the days of Paul Bunyan the world has steadily advanced through a maze of bewildering improvements. What is a fad today is unique tomorrow. People talk of the old-fashioned girl and the good old times they used to enjoy. That is where the Foresters' Ball surpasses even the old-time functions in a real democratic, jolly get-together party. Perhaps this very democracy is what enables it to surpass other social functions.

There are all kinds of social functions held on the campus during the social season. They range from formal affairs, when the men wear "soup-and-fish" and the ladies rival birds of paradise, to functions where gay costumes depict all stages of life, but none can compare with the Foresters' Ball, where the dress is that of the great out-doors. Here "cod-fish" aristocracy is laid aside and in its place honest good fellowship and naturalness prevail. Each is free at last to give full vent to that long-pent-up hilarious good feeling, and to have as thoroughly a good time as a boy with his first ball and bat.

It is not only that the Foresters' Ball can outclass any other social affair, but it can outclass as well any social function staged in the entire state. There were eight hundred participants in the Eleventh Annual Ball. However, the purpose of the ball is not for conquest or financial gain, but to solidify and unite the student body into one grand, democratic organization. Each student is given an opportunity to enjoy an evening free from

rocks and work up a good appetite. Jerry had his bunch out surveying, and Fay had his class in mensuration out in the woods on volume tables and growth studies.

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restraint, and each charming co-ed can feel, that no matter how slim her allowance might be, her costume is entirely appropriate. Her escort does not need to wonder if his lady love suspects that his "soup-and-fish" is rented. Regardless of your fraternal or sorority standing, you are on par with your fellowman and unconsciously you are learning the true purpose of education.

* * * * *

One pauses expectantly, wondering which pleasure will claim him first. The stars peer at him coquettishly through dark fir boughs. The entrancing music ensuing from the snug wickiup makes his feet trip and dance of their own accord. The happy-go-lucky throng of dancers seems to say, "Join us now! Join us now!" The corks popping in the bar-room and the laughter and shuffle of feet is a contrasting rival to the dim repose of the Ranger's Dream of Heaven, where couples are silhouetted against the ruddy glow of the fireplace, while others stroll through dusky timbered recesses.

At last he succumbs to the irresistible appeal of the music, and claiming a rosy-lipped senorita for his partner, he joins the swirl of bright dancers. Soon his fair lady must have her thirst quenched at the old-time bar and must needs then rest her nimble feet on a woody slope beside a dark fir tree in the Ranger's Dream of Heaven, which they soon claim as their very own.

Finally the big gong sounds, a welcome announcement that the first three hundred are to eat. Here the surprise of surprises awaits them. (The eats must have been exceedingly good or the dancers amazingly famished, for though there were but eight hundred dancers, over a thousand were fed.)

As the strains of "The End of a Perfect Day" dies away, weary revelers wonder if it will ever be their good fortune to again attend such a ball. More than one sympathizes with the sweet young thing, who exclaims fervently, "I've danced until I'm just dead tired, and I never knew it."

THE CLASS OF 1925

By H. W. HICKS.

After four years—at least that is the minimum that any of us have been struggling for this coveted honor—eight men will go out from Montana this year as graduate Foresters. It has been a rough sea for many of us, but the goal is well worth the effort. Education in Forestry, as in all college training, consists not only in the study of Silviculture, Mensuration, Forest Management, Grazing, Surveying, etc., but in the broadening of one's mind along other channels. It was once said that, "an educated man is one who knows everything about something and something about everything," and it has been with this axiom in mind that this year's class has strived.

At the head of the list comes the name of Raymond Bitney from Wisconsin, who has been a very active member of the Forestry Club for four years. His hobby has been shooting and he has been a member of the Rifle Club during his four years of school life, being president of the organization for the past two years. As manager of the Forestry Kaimin in 1924 and 1925, Ray has handled the business end with great success. Phi Sigma, national Biological fraternity, has been fortunate in having him as an active member for the last two years. Bitney was a charter member of the Druids, honorary Forestry fraternity, *helping to organize it* in 1923-1924 and was vice-president in

1925. He worked for the state forester on the Stillwater State Forest last summer, making working-plan studies under Dorr Skeels.

Linnell W. Brown, of Davenport, Wash., has also been an active member of the class. As student assistant in his junior and senior years, Walker has become quite adept with the level and transit. He handled the money for the Druids the last two years. The Forest Club has chosen Brown as its vice-president the last two years. Last summer he was assistant chief of party on a fire survey in the Selway National Forest.

Willard Centerwall is the athlete of the class, having won his letter "M" in baseball the last two years and is well on the way to another this year. Spitballs are Center's favorites, as the conference rulings show. Last year he worked as concrete and bridge inspector for the Minnesota Highway Commission.

Arthur Cramer has been a very active member in the Rifle Club while he has been in school, having been vice-president the last two years. Botany is Art's hobby, and nothing pleases him more than to find some unknown plant and trace it down. This interest in Botany led to his joining Phi Sigma, where he has been a very active member. He is a Druid and a member of the Forestry Club. Last summer he was with a grazing reconnaisance party in the Helena National Forest and is now waiting for an appointment as junior grazing examiner, having passed the Civil Service.

Ralph Fields, who hails from Ada, Ohio, is one of the gradepointers of the class, making Kappa Tau, honorary scholastic fraternity, last year and will graduate with honors this year. Ralph has been a very active member of the Forestry Club, was on the executive committee two years ago, and was president of it last year. He belongs to Phi Sigma and Sigma Phi Epsilon. This year Fields is general chairman of the Interscholastic, one of the biggest events of the school year, over a hundred high schools from all over the state coming to Missoula to compete in the various field events. He was in charge of decorations for two years for Interscholastic. Ralph is a charter member of the Druids, was vice-president the first year, and was really the founder of them. He is waiting for an appointment as junior forester, having passed the Civil Service.

Harold W. Hicks, from the nation's capital, came out to Montana to get into some "real" country and a real profession. His first two years were spent in the University of Cincinnati taking chemical engineering, but the "call of the West" got him, so he is finishing up in Forestry. He has been a member of the Forestry club, being secretary of the organization the last year. Hicks is also a member of the Druids. Last summer he worked for the Priest River Experiment Station, getting data for White pine yield tables and making studies in White pine reproduction in the burned over areas of Idaho. This summer he expects to pull Ribes in an effort to check the White pine blister rust out in northern Idaho, as he passed the junior forester's examination.

Bernard Lee comes from Wisconsin, and has been an active member of the Forestry Club for four years. Bernie is a Druid and a member of Phi Sigma, national Biological fraternity, as he is interested in Botany. He took the junior range examiner's examination and passed, so is waiting patiently for an appointment.

Tom Rowland is another grade pointer who made Kappa Tau, honorary scholastic fraternity. He expects to graduate with honors at the coming commencement. Tom has been an active member of the Forestry Club, being treasurer this last year; also belongs to the Druids and served as president the last year. Rowland belongs to Phi Sigma, as he is interested in Botany. Last summer he worked for the state forest department on management studies on the Stillwater forest. As Tom passed the junior forester examination, he is now waiting his appointment.

It is easy to see from the list of activities in which these men have been engaged in during their college careers that they will go out from the University better fitted for their life work than the student who becomes only a "bookworm" and learn his Forestry, but has nothing else in common with his fellowmen. It is with regret that we leave old Montana, but the daily cry of "Carry on" compels us to begin our task and make room for those who will follow.

Am I contented? I don't know.
I've all I really need.
My belly's full—my back is warm—
I have a book to read—
(Food for the body and the mind!)
But yet there is a seed—
A tiny germ of restlessness—
Contented? No, indeed!

JOHN C. FROHLICHER.

FOREST SCHOOL NURSERY

By R. H. BITNEY.

The primary object of the nursery is to give the students a first-hand opportunity to study the tree-seeds, germination, care of seedlings, transplants and general nursery practice. The secondary object is to furnish the residents of Montana with shade trees, especially the ranchers in the eastern part of the state. Special studies are now under way to determine the species best suited to the dry climatic conditions of eastern Montana.

A year ago last Aber day, the first work was done on the nursery, the beds being laid out and seeded. In the fall the beds were mulched and put in shape for the winter. Last winter was especially hard on nursery stock, but the seedlings came through it very successfully. Despite meager appropriations from the State the work has progressed, the major part of it being done by the students. At the present time there are over fifty 4x8-foot beds with seedlings from all the trees indigenous to the West, with a large number of horticultural varieties. The tool house is located just south of the gymnasium and was built by students on the above mentioned Aber day.

So far the greatest amount of success has been obtained with box-elder *(Acer negundo)*, which will be one of our best suited species for ornamental purposes. A large number of coniferous seedlings are now in the nursery, and these will be used to plant the forest reserve in Pattee canyon and to carry on experimental projects at the base of Mount Sentinel. It is hoped in time that it will be possible to supply private timberland holders with enough nursery stock to carry on large planting projects.

A. G. O. 29

The men who showed their courage in the battle of the Marne and on the blood-stained plains of Picardy and at the crossings of the Meuse are now emerging victorious from the slow, dreary battle that became its peace-time sequel. No citations for bravery have been awarded, no hero-worship has been their mead of victory. No glory but the realization of a well-earned place in society and a new chance to contribute in some measure to the advancement of their communities, has been their incentive in their wearying fight. With courage they carried on in the days of horror and human holocaust. With unflagging fortitude they are carrying on in these days of slow grinding social and economic rehabilitation.

Pain-stricken bodies, jangling nerves, steel-bit limbs and ears that hear no sound, are not the only handicaps with which these men are burdened. Many of them have not attended school since the day when, 10 or 15 years ago, they *went out to make* their own way in the world with only a fourth or fifth grade standing in the little old log schoolhouse. Very few of them had attained matriculation into a high school. Yet, with the loyal support and encouragement of the United States Veterans' Bureau, they have established a record that is far above the average of the regular university students who are their schoolmates.

The Veterans' Bureau students in the School of Forestry afford a good example of the determination with which they who were formerly the "Lads in Khaki" have applied themselves to the problem of "beating back." In view of their physical handcaps and of their meager educational preparation, their record is little short of amazing.

Here are a few quarters' records picked at random from the files of the School of Forestry:

In the Autumn quarter of 1923 there were 25 Veterans' Bureau trainees. Six of them were on the university honor roll, and of the 10 students having the highest averages in the School of Forestry, six were from among this same group of 25. There were 62 regular students in the School of Forestry during the quarter mentioned. Of this number, four were on the honor roll.

During the Autumn quarter of 1924 there were 15 Veterans' Bureau students studying forestry. Of this number, four won places on the honor roll of the university and six were among the highest 10 in the School of Forestry. Out of 71 regularly enrolled students in this school, two were on the honor roll, copping four of the highest 10 averages made by forestry students.

In the Winter quarter of 1925 there were 22 Bureau trainees and 58 regularly enrolled students in the school. Seven trainees and three regular students were on the univrsity honor roll.

During the quarter just ended the Veterans' Bureau students continued this pace. There were 15 of them enrolled as students of forestry. Of this number, four earned places on the honor roll, the same number being among the highest 10 in the school, while out of 68 regularly enrolled students, four were on the honor roll, six of them completing the total of the highest 10.

During the period of training an average of 19 Veterans' Bureau students have been registered in the School of Forestry. An average of five have been on the university honor roll, and an average of six have been among the highest 10 in the school. During this time the average number of regularly enrolled students in the school was 65. Of this number, an average of three were on the honor roll, four being the average number among the highest 10 in the school.

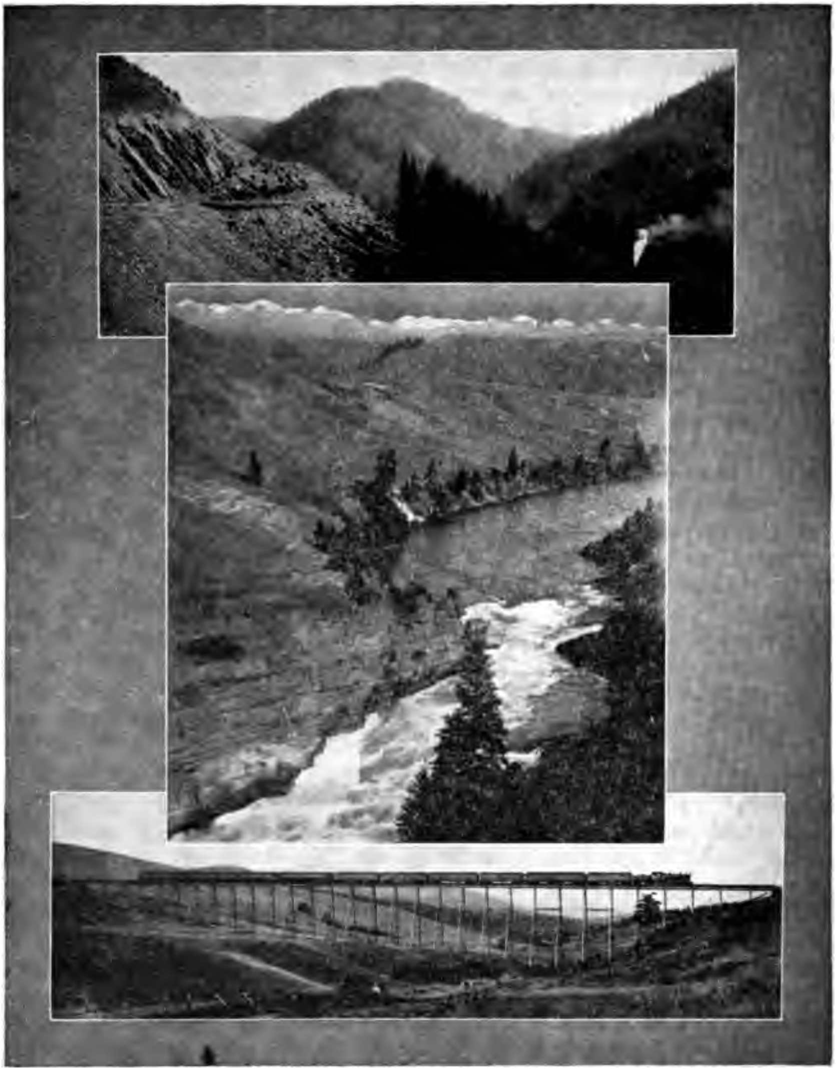
Presented in statistical form, the comparison is even more startling. Twenty-seven per cent of the total number of

Bureau trainees have been on the honor roll; four and one-half per cent of the regularly enrolled students have attained that honor. Thirty-one per cent of the trainees have been among the highest 10 in the school, while six per cent of the regular students have been numbered among this select 10.

This record has not been made by a sacrifice of other interests and activities. Since the time when they first came upon the campus, the men who made this record have been active—prominently so—in the various social and athletic affairs of the University. During the last few years a majority of the social fraternities, and a number of the honorary and professional fraternities, were managed or presided over by men receiving training under the Veterans' Bureau. Trainees have been prominent in debate, declamation and Glee club work, and those who were athletes before the war and whose injuries did not render it impossible for them to resume their athletic endeavors, have earned letters in football, basketball, track and baseball. A trainee who experienced considerable pain upon merely walking down the street became captain of the football team. Another trainee played in game after game though at times his injuries made him unable to rise from the scrimmage line. He silently endured the cries of "Yellow" until physicians peremptorily ordered him to stay off the field. Another man, who never mentions the Croix de Guerre with which he was decorated, became one of the university's most famous Kings of Swat and a star in the outfield and behind the plate. The spectators little dreamed that the man who made those mighty swats had his back tightly trussed up with a brace, or that the following night would find him writhing in torturous pain.

And so they carry on, smiling—with lips that in an hour may tense with pain; running—on legs that are a mass of shrapnel scars; laughing—those same men cursed a sniper's singing steel; reading—with eyes that once were almost glazed with death; throwing—with arms that once were burdened with a dying buddy's body.

Heroism? Hell no, they'll tell you! The government has given them a chance to go ahead again, and they're the boys to take advantage of it. The Veterans' Bureau, they'll say, is playing square with them, and they'll do no less by the Bureau—that's all!



MOTOR TRIPS

There are many trips which are inexpensive and require less than a day to make and return by motor. Some of these are: Seeley Lake, Flathead Lake, Swan Lake, the Rattlesnake Lakes, *Lolo and* Medicine Hot Springs, and the Bitter Root River to *Hamilton.*

RECREATION

The University city has a population of more than 15,000 and provides all the opportunities for recreation commonly found in a much larger city. Missoula is, however, unique in that it has the unspoiled West just beyond its city limits.

SPRING GULCH

Spring Gulch is reached by a ten-minute walk from Pinchot Hall, along the shore of the beautiful and historic Missoula River. This little gulch with its icy spring and fir-hidden nooks is just the place to recuperate from the day's grind, provided, of course, a bear more or less only adds zest to your recreation. (A small bear was killed in Spring Gulch last month.)

MT. SENTINEL

Mt. Sentinel towers above the campus on the east. Upon her breast she proudly wears an "M", to which she has an inalienable right. She has been on the campus for a long time. The old lookout tower on her crest is a favorite goal for the hiker. The visibility of this point is excellent. It includes all of the city, Fort Missoula, three silvery rivers and numerous snow-capped mountains.

PATTEE CANYON

A thirty-minute walk south of the campus brings you to the mouth of this canyon. A winding road entices you. You are soon lost beside a flower-decked stream. The hiker who visits this spot will long to return again.

HIKES WHAT AM

Many spend the summer vacation hiking through the National parks. The Yellowstone and the Glacier National are both near enough to Missoula to make these trips both feasible and appealing to anyone.

THE INDIAN RESERVATION

The Flathead Indian Reservation is one of the points of interest which is within easy access of our University city. A drive of thirty miles by car or stage, over excellent roads, brings you in contact with the survivors of the original American people. On numerous feast days they may be seen in all their tribal glory. The gaudy trappings and the tribal rites and dances far excell any of the studied pageantry often foisted on the public as genuine Indian dances, by hired performers. The shrill war whoop, the tom-toms and writhing war dance make the heart beat fast and, in spite of yourself, you are transported back into *a bygone age.*

SUMMER EMPLOYMENT

GEORGE A. BARNHART:
Employed during the summer on the Kaniksu National Forest above Priest Lake on white pine blister rust control.

H. H. VANWINKLE:
Employed during the summer on the Kaniksu National Forest as lookout.

REMLEY E. MYERS:
Employed during the summer on the Teton National Forest; character of the work was topographical mapping, timber estimating, and tabulation of data for working plan.

WALTER R. SUTTER:
Employed during the summer on the Mons National Forest, Alpine District, California, as assistant ranger.

SAM F. HARRIS:
Was employed by Long-Bell Lumber Company at Longview, Washington, as scaler and lumber grader.

HAROLD RUSSEL:

Teton National Forest on timber reconnaissance work.

THOMAS H. VAN METER:

Employed on Missoula National Forest on telephone construction, trail maintenance and lookout.

LARUE THOMAS:

Worked on the Pend d'Orielle National Forest on trail crew work, and as timekeeper for fire crew.

R. E. TENNANT:

Worked at the A. C. M. mill at Bonner, Montana, sorting lumber, trimmer man, edger, etc.

EARL TENNANT:

Employed by Flathead Indian Service on telephone construction, drafting, surveying, fire patrol and scaling.

J. B. STOCKING:

Lewis and Clark National Forest on fire patrol and maintenance work.

MATTESON S. SPENCER:

Kaniksu National Forest as foreman on white pine blister rust control crew.

CLARENCE SPAULDING:

Lookout and smoke-chaser in the Copeland Ranger District on the Pend d'Orielle National Forest.

DONALD W. SHAW:

Teton National Forest on intensive and extensive cruising of lodgepole tie timber and topographical mapping.

We Fish with an Axe in Montana.

Bringing Home the Bacon.

Harold C. Peterson:

Timber cruising, for the U. S. Forest Service, Department of Lands, District No. 1.

Briggs, Lund:

Worked on Minoe road location, control lines for timber estimator and homestead surveys, with the Department of Engineering, U. S. Forest Service, District 1.

W. E. Dunstan:

Employed on Flathead and Nez Perce National Forests doing topographical surveying.

W. L. Young:

Worked for county surveyor of Gallatin county, Montana, on road rights-of-way and checking cuts and fills.

Raymond J. Bowers:

Employed on Stillwater State Forest, Montana, as fire warden and scaler.

Raymond H. Bitney:

Employed on Stillwater State Forest, Montana, getting data for working plan.

John B. Thompson:

Employed on Stillwater State Forest, as fire warden and *scaler.*

JOHN BAGGS:
Bitter Root National Forest; measuring water in creeks and into ditches; estimating water from dam and pressure in the lake. Employed by the water users of Bass Creek.

FORCE BANEY:
Kootenai National Forest; assistant ranger.

C. H. BLOOM:
Selway National Forest; cruising timber.

L. W. BLOOM:
Selway National Forest; fire and timber survey.

ROY H. CANFIELD:
Helena National Forest; intensive grazing reconnaissance.

E. W. COOPER, JR:
Missoula National Forest, Gold Creek District; packer.

JOSEPHINE DARLINGTON:
St. Joe National Forest; lookout.

HERBERT W. EVERET:
Missoula National Forest; telephone construction, trails, and lookout.

HAROLD W. HICKS:
St. Joe and Coeur d'Alene National Forests; collecting data for white pine yield table.

CHARLES KUMLER:
Nez Perce National Forest; lookout and smoke-chaser.

The End of a Perfect Day.

Stanley M. Libby:
Bureau of Plant Industry in northern Idaho on blister rust control.

Stanley M. Lukens:
Savenac Nursery, Haugan, Montana; examination of old plantations and planting surveys.

Milton Ritter:
Cold Springs Ranger Station, Superior National Forest, Minnesota; trail and portage work.

Lawrence McDonald:
Idaho; on white pine blister rust eradication.

LeRoy A. Merryfield:
Montana State Forestry Department; worked on land classification and exchange.

Everett E. Richards:
Flathead National Forest; lookout.

Thomas E. Rowland:
Montana State Forestry Department; gathering data necessary for working plan.

Alban Roemer:
Cabinet National Forest; smoke-chaser and lookout.

The End of the Season.

MONTANA'S TIMBERLAND TAXATION PROBLEM

(Continued from Page 49)

your investment and can be charged, without interest, against operating expenses. This tax has been variously applied at from 6% to 10% of the value of gross yield. This appears heavy—but it is an accumulation of deferred tax obligations payable at a time most convenient to you.

(f) If the sudden application of this form of timber tax deprives countries or other political subdivisions of necessary revenues provision can be made to commute a part of the yield tax to a yearly basis at the normal rate of interest paid by the State, county or other subdivision on all outstanding accounts. The summation of these yearly payments between the application of the law and the year of cutting may be subtracted from the yield tax due when the timber is cut. The remainder would constitute the net yield tax payable. By using current stumpage values as bases for calculations, adjustable only over five or ten-year periods, the commutation should not exceed the normal yield tax,—except when lands may be left uncut for a long period of time. Provision for adjustment in contingencies of this kind might readily be adopted.

This tends toward the present form of property tax. It has the advantage of certainty, freedom from local whims and politics, and guarantees the lumberman an opportunity to forecast his profits more clearly than at present. Again, if the timber is destroyed by fire, his tax ceases except for the soil tax.

There are several forms of this yield tax. Some have been successful. Others not. Massachusetts has had laws similar in intent for a decade or more.

It must always be borne in mind that for the present at least a transferance from the present form of timber tax to a formal classification with its yield tax basis must be optional with the owner of the cutover or timber land. He can and should be permitted to choose.

Montana Forest.

FIRE-WEED

Where the black scar of vanquished fire was made,
Darkening the loveliness of forest green
With obscure threat, as when a cloud is seen
To turn bright waters murky in its shade,
In the springtime a shining cavalcade
With purple trappings shall venture along, between
Charred, goblin stumps, and blackened limbs that lean
Criss-cross to earth like fears in flight delayed.

Oh, valiant weed Toss up your blooms to the light!
Purple means grief, but royalty as well.
You are a challenge to the ravaged soul.
Transmutor! Making cripppled beauty whole!
Blazing new trails to make dark vistas bright,
Spreading slim roots where mightier verdure fell!

MARY BRENNAN CLAPP.

Dwarfed Alpine Pine, Mission Range.

THE FORESTS OF THE BITTER ROOT MOUNTAINS

(Continued from Page 39)

as the controlling factor in the local distribution of the species in this part of its range.

In the moister areas of the Montane zone the white pine may become dominant, sometimes pure but often mixed with lodgepole, grand fir, western larch and mountain hemlock. In the northern parts of the Clearwater where precipitation is ample thousands of square miles were formerly covered with a dense stand of this species which was destroyed by fire in 1910 and subsequent years. Some areas are still green, samples of what was lost by the conflagration. Regeneration of the burned forest is slowly going on, but it is practically doomed by the fire risk of the deadened timber.

The white pine is the most valuable tree of these forests but it is also the most sensitive to drouth, fire and disease. Its prevalence is indicative of a climatic condition very similar to that of the humid transition, the more adaptable species of which often mingle with those of the cooler overlying Canadian Zone.

The Engelmann spruce is a forest tree of wide distribution, occurring here at altitudes from 4000 feet to the upper limit of tree growth. It thus extends its vertical range over two zones, although it can seldom be found dominant in the Canadian. At lower levels it appears sparingly in sheltered gulches along water courses, and with increasing frequency toward higher elevations where it is widely diffused through various situations. While always dependent upon considerable soil moisture its local occurrence apparently is limited more sharply by a comparatively high atmospheric humidity. Consequently on the eastern slope of the Bitter Roots it is general in its distribution only at comparatively high elevations while on the west side its area of general occurrence extends much lower.

One of the trees strictly confined to the Canadian Zone is the western larch. Its vertical range in the Bitter Root Mountains is mostly between 3300 and 5000 feet, on creek bottoms and northern slopes. Its zone of distribution can be clearly seen in the autumn when the leaves turn yellow and stand out in sharp contrast to the dark green of pine and spruce. While decidedly partial to moisture in its environment the temperature factor must here be recognized as influential in its local occurrence. The Bitter Root Mountains represent the southern limit of its distribution in the Rockies. As the higher temperatures are the determining factors at the southern boundary of specific ranges it follows that species will cling to the localities and exposures where suitable temperature conditions are preserved. Such behavior is not a feature of the lodgepole pine and spruce in this area which lies far within the bounds of their natural distribution.

The Hudsonian Zone in the Bitter Root Mountains extends from the upper limits of the Canadian to the timber line. Timber line in intermediate latitudes differs materially from the polar boundary lines of forest growth in the diurnal variations of temperature and illumination and the differences of atmospheric pressure and movements. High moutnain tops and polar latitudes, however, are both psysiologically deserts, though not operating precisely in the same way. In the case of the mountain tops, with which we are concerned here, the desiccating influences of wind, rarified air and cold increase with the altitude. When these conditions become insupportable by trees, timber line is reached. But since the velocity of wind and the temperature varies with exposure and location, the level of timber line may vary on the same and on different peaks. On most of the Bitter Root summits no timber line is apparent. Only where the peaks rise isolated and high do we find their summits partially or wholly bare. A striking instance of this is seen in Trapper Peak where a definite timber line occurs at an altitude of approximately 9500 feet and the summit rises several hundred feet higher with bare rocks or characteristic alpine matted vegetation.

The trees of the Hudsonian or sub-alpine zone in the Bitter Root Mountains are the sub-alpine fir, Engelmann spruce, whitebark pine, Lyall's larch and mountain hemlock. The shrubs are chiefly heaths, subarctic willows and alders. The spruce and fir extend downward along the streams into the Canadian, but with the pine constitute the dominant species of this belt. The pine appears first conspicuously above the Canadian and in old stands may be uniform, orchard-like, with cylindrical boles and rounded tops. In the higher levels of their range they become more sparse and irregular. The typical sub-alpine forest is one of groups of trees scattered over meadow-like areas or "parks." This may be partly the effect of intolerance induced by the severity of the conditions, but may also be attributed to soil conditions and competition with herbs and shrubs in the seedling stage.

The most interesting of all the trees of the Hudsonian forest is Lyall's larch. It stands aloof from all the other trees of its zone, clear above them in altitude, braving the gales with erect rigid stems and vigorous outstanding branches. Its summer is brief and stormy and its winter long and rigorous, with intense cold and driving winds. Its growth is exceedingly slow and its annual rings can hardly be counted without the aid of a lens. An unusually large specimen of its kind stood on the south slope of Trapper Peak. It was less than two feet in diameter with an estimated age of around 600 years. Here this tree also, like its relative the western larch, finds the southern limit of its range in the Rocky Mountains.

The Mountain, or black, hemlock as it occurs in this area is found mostly in the drainage of the North Fork of the Clearwater River, where it is actually dominant in many localities from the mountain tops down several hundred feet. It is mingled often with other trees of its range, the whitebark pine, fir and spruce. It is a singular tree in its appearance and habits and can scarcely fail to be noticed even by the casual observer. Its frequent association with the white pine and its partiality to regions of heavier precipitation indicate moisture as the prevailing factor in its abundance and distribution.

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Of the Alpine Zone in this region there is little to say. It lies above the lines of forest growth and as stated above is of very limited area. Its low vegetation, however, in relation to the strenuous environment is an interesting subject for study. In another respect also it deserves attention and that is from the standpoint of its sources and past history. It is the least known of the botany of our region, probably because of its isolation and the brevity of the season during which it is accessible.

LAND CLASSIFICATION AS A PART OF THE NATIONAL FOREST WORK IN MONTANA AND NORTH IDAHO

(Continued from Page 68)

lands of this character could not be classified as chiefly valuable for agriculture. They also concluded that the classification could not be considered permanent. Upon the removal of all or a part of the timber through logging operations which would ultimately take place, the relation between the value of the land for agriculture and for forestry might be reversed in that even though the lands would still have a value for forestry, the removal of the timber, which had been a part of the land, might so reduce the aggregate forestry value that the value for agriculture would outweight it. As a corollary of such a policy, these lands would not be obtained by those interested in acquiring the land for the timber on it and thereafter transferred to the ownership of timber holders, but if ultimately found to be chiefly valuable for agriculture, would be thrown open to bona fide settlers whose interests would lie in developing the land for agricultural use. Furthermore, these bona fide settlers would obtain this land free, whereas if it became available to them only after title to it had passed through the hands of a timber owner, they would have to pay that timber owner the full market price of the land.

There is the second phase of current work in land classification. Conditions change. Concepts become more definite and may vary from previous concepts. In such a large job as the general classification, some errors, due to human fallibility, are unavoidable and to be expected. After the classification of any particular National Forest was finally completed, approved, and become established, it was found, occasionally, that a correction in the classification of some particular tract might be necessary.

On the one hand, a relatively few scattered tracts, classified originally as chiefly valuable for forest purposes, were

found, upon more close investigation based on re-examination, to be properly classifiable as chiefly valuable for agriculture. There were, however, many requests made for reclassification which after field examination could not be acted on favorably. This was to be expected, since these lands had been examined carefully by experts, and their errors and oversights would be only few. Consequently, it is the policy to place the burden of proof, that the findings in regard to any tract were incorrect, upon those who question the findings. Individualls who are interested are asked to file, as a part of their requests for review of classification, data regarding topography, soil, climatic, and other conditions, which would support the contention that the lands have a real and permanent value for farming superior to their value for National Forest purposes, and that therefore, the classification hitherto made is erroneous. Where such showings raise a doubt as to the existing classification, a re-examination is directed. Considering the vast amount of territory covered by the original classification work, there has been very little correction of classification to be made, even though in the last 15 years and subsequent to the completion of the general classification work the Forests have been very finely combed over by people seeking opportunities to exercise their homstead rights in establishing a farm home.

On the other hand, experience has shown that some areas at one time considered chiefly valuable for agriculture are not after all in fact chiefly valuable for the production of farm crops. Either such lands have been refused by prospective homesteaders, or have been entered and abandoned, in some cases by as many as three or four entrymen, who have

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found that they could not successfully cultivate such lands. The influences which have affected the use to which these lands have been put, are a reflection in small part of the general agricultural trends of the country. For a long period up to about 1920, there was a great demand for farm lands which resulted in attempts to put under cultivation lands which the agriculutural economist terms submarginal. By this is meant lands which for agricultural purposes are poorer than the poorest lands which through experience under existing economic conditions, have been found profitable to use for producing farm crops. For the last four or five years learned students and careful investigators of the agricultural land problem in the United States have asserted that what is needed as an adequate farm land policy in the country is not the putting under cultivation of any more lands; as a rule these of necessity would be of the poorer class from the standpoint of crop production and accessibility to market, since naturally the better lands and in the better localities would have been first picked for farming. Rather they find that better farming methods on lands already under .cultivation would be advantageous, since the increase in return through an added intensiveness in farming practice on such lands would be greater than the production through a corresponding amount of effort on the poorer lands.

That these findings are correct, has been proved by the

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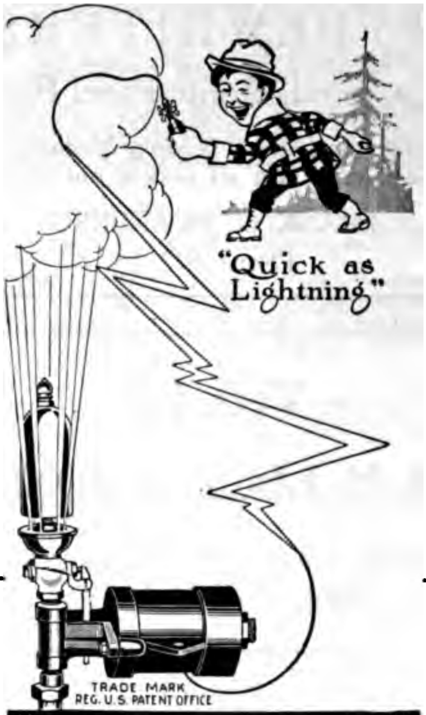
very distinct reduction in recent years, of the area under cultivation and of even the number of farms, particularly in Montana and north Idaho. While it is true that in some individual cases men especially qualified, or under a particularly fortunate set of circumstances, have been able to persist in farming sub-marginal lands, they are exceptions. Economic laws are immutable and the Government's land policy must be based on these economic laws, since the Government's action must have in mind the welfare of the general commonwealth in the long run. So it occurs that a small portion of the areas originally classified as chiefly valuable for agriculture are now found to be truly submarginal, and hense less valuable for agriculture than for other purposes to which they can be put as permanent parts of the National Forests in which they lie. In such cases also cor-



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rections are being made of the classification where title has not already passed from the Government.

The third phase is a very important and constantly growing need for land classification wherever forest values exist whether inside or outside the forests. Under the General Exchange Act of March 20, 1922, the way is opened for the establishment of Government title to lands in the National Forests now privately owned which are chiefly valuable for timber production or watershed protection. These lands must be very carefully examined and intensively classified, since it is the aim not to acquire any areas which are chiefly valuable for agriculture.

The Clarke-McNary Act of June 7, 1924, provides for the addition to National Forests of outside government-owned lands which are chiefly valuable for watershed protection and timber production. These lands must also be classified, since lands chiefly valuable for agriculture are not desired. This last work requires especially intensive analysis, since virtually all of the lands which are to be considered for such addition are much more accessible than the National Forest lands and lie closer to developed and growing farming regions in whic the lands are truly agricultural in character. The boundar

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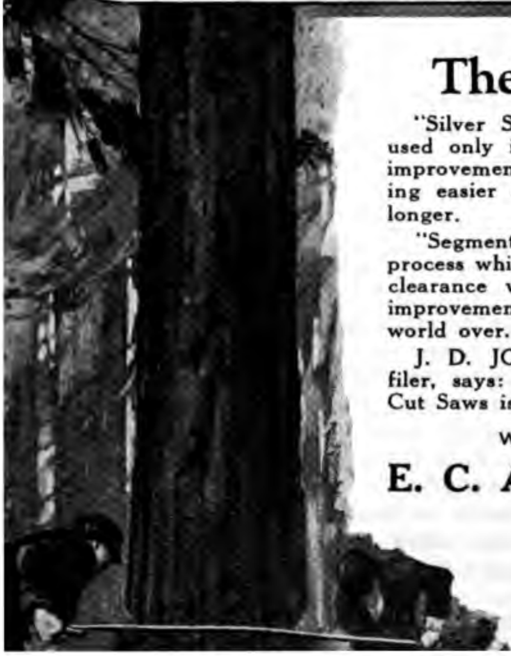

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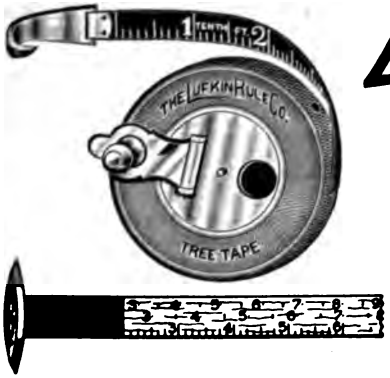

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between lands which will always best be used for forests, and those which ought to be, for the common welfare soon, and permanently, put under agriculture must be closely determined. There are large areas of such lands to be considered in various localities in Montana and north Idaho.

It is quite possible that there will be other acts from time to time for the purpose of adding to National Forests, lands which are chiefly valuable for timber production and watershed protection and which their present owners are either unwilling or cannot afford to administer and protect. These will have to be classified.

The land classification work in connection with all these acquisition laws, involves the very fundamentals of land utilization and is therefore basic to the practice of either agriculture or forestry.

In the present land classification practice of the Forest Service, certain definite principles are kept clearly in mind in determining whether a piece of land is chiefly valuable for agriculture.

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The land must be of greater permanent value for agriculture than for timber production or watershed protection, the primary purposes for which the National Forests were created.

The use and need of the land for agriculture must have a sound economic basis. Its acreage and soils must be such as to afford the reasonable presumption that under the growth conditions controlling its use, it will produce crops sufficient in quality and quantity to justify the cost of labor, equipment and implements, required to bring it into, and permanently maintain it in a state of cultivation.

Its occupancy for farming purposes must not injure the National Forest by unduly increasing the hazard of protection, the difficulties of administration, or the obstacles to proper economic utilization of all the resources of economic importance upon tributary National Forest lands.

The land must not be needed for public purposes such as National monuments, administrative sites, public camp grounds, municipal water supply, reclamation work, or quasi public uses like water and irrigation developments.

In classifying a piece of land under these principles, a *very intensive investigation* is made, on the ground, of the

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UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

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METEOROLOGY FOR 1895,

AND

NOTES ON CLIMATE FROM 1891-1896.

BY THE METEOROLOGIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

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Agricultural Experiment Station.

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METEOROLOGY FOR 1895,

AND

NOTES ON CLIMATE FROM 1891-1896.

BY J. D. CONLEY.

The Experiment Station commenced its meteorological observations in the early part of 1891, and has issued a report each year, the first one being quite extensive, figuring most of the apparatus used in the department, and explaining its use. After the first Bulletin, this, the fifth report, seems of the greatest importance, since we have sufficient data to make an intelligent comparison and formulate for all practical purposes a general idea of the climatology of the various regions of the State, from which we have observations reported to us monthly. While it takes 20 years, or more, to establish accurate scientific data as to the climatology of any region, yet the careful comparison of the observations of temperature, rainfall, directions and velocity of the wind, etc., will give so near the normal conditions in these respects, that one will be enabled to form an intelligent opinion of the climatology of the northern, eastern, central and southern portions of our State, the regions from which we have had regular reports for the past five years.

There is such a close relation existing between crops and climate and soil, that the Meteorology and Soil Physics come under the Weather Division of the Agricultural Department of the Government.

The study of Meteorology does not consist of comparing dry tables of facts and statistics, but the study of such authors as Flammarion on the Atmosphere, and Ferrel on the Winds, is as interessing, instructive and fascinating as our most popular literary works, even from a rhetorical standpoint. Davis' Elementary Meteorology, American Weather by General Greeley, Climatology and Time, and Climate and Cosmology by Croll, show what rich fields of thought and depth of research the Science has investigated, and is still pursuing. We can hardly estimate the great advantages of the Signal Stations scattered throughout the country, giving to the farmer, the shipper, and to the community at large, due warning of approaching storms and cold waves, so that preparation can be made for their reception.

We have suggested that there is a close relation existing between Climatology and crops. The experiments on our farm at Laramie (altitude 7,200 feet, the highest altitude of all the Experiment Stations of the United States) together with the weather reports, form rather an unique experiment in itself, among the group of Stations. One studying the weather report alone, would predict a poor crop; but our Museum in the Agricultural Department of the University has as fine a display of cereals and root crops from the Laramie plains, as can be produced in the United States. The fact has been established that the nights are too cold during July and August for corn, yet roasting ears have been grown at Laramie.

But our Museum illustrates to the world what can be done in the way of agricultural products, and the study of our Annual Crop Reports illustrates the wonderful influence of the weather over the crop reports for the various seasons, the crops varying with the fluctuations of the weather.

The automatic apparatus that we have added to the department within the past two years for recording the directions and velocity of the wind is of such excellence and interest that we give herewith a cut and description. The first Bulletin issued on Meteorology was in 1891, in which were figured most of the instruments used for taking observations. That issue being nearly exhausted, it is thought best to give the figures in this issue, together with the interesting apparatus that has been added since 1891.

We feel that a few general remarks in regard to the weather will not be out of place here, for this Bulletin will fall into the hands of many who have not lived in an arid region, and in reading the tables in regard to climate, rainfall, velocity of the wind, etc., will form an absurd idea as to the real conditions of the weather as experienced by the inhabitants of such regions.

The statement is not too strong when we say that the climate of June, July and August is the most delightful of any region in the United States.

While our Winter temperature will average a little colder than that of New England, New York and Illinois, yet the high altitude and the consequent rareness and dryness of the atmosphere more than counterbalance the difference in temperature. While the weather is from 10 to 20 degrees colder here in the winter than in the above named States, yet it feels much warmer.

It is the unanimous verdict of persons who have come from said regions that our winters are much pleasanter, due to the dryness of the atmosphere, and that our winters seem much warmer.

On the very coldest days the atmosphere is still and dry and clear. But when there is an east wind, laden with moisture, it is apparently from 10 to 20 degrees colder than the real temperature indicates.

In order to predict what the weather is going to be, even within twenty-four hours, the following data is essential—whether the barometer is rising or falling, the temperature, the dew point, the relative humidity, and the direction of the wind. These facts will enable a careful observer to foretell with a considerable degree of certainty what will be the condition of the weather for several hours in advance.

We insert some simple and general laws in regard to the movements of the barometer:

The barometer is high when the air is cold, and when the air is dry.

The barometer is high when the lower stratum of air is heated, when the air is damp, when the air has an upper movement.

We therefore observe that the rising and falling of the barometer alone is not sufficient data from which to foretell the conditions of the weather.

The following taken from the United States Department of Agriculture Weather Bureau, under "Instructions for Voluntary Observers," is of such general practical value that we publish it here, hoping that some observers will volunteer to send us information in regard to some, if not all, the questions asked. All of the points are of great importance in working out the problem of the agricultural possibilities of our new commonwealth.

GENERAL PHENOMENA OF CLIMATE.

Information of a general character relating to the growth of plants will be of value in compiling the Climatology of a district. It is suggested that where voluntary observers can do so, the following be included in their records:

Time of plowing in the spring.

Time of planting various crops.

Time of appearance of same above ground.

Time of flowering of strawberries, currants, raspberries, apples, plums, and other fruit.

Time of commencement of haying.

Time of commencement of harvesting the various cereals.

Time of ripening of various fruits.

Time of first killing frost in the fall.

Time of last killing frost in the spring.

Time of sowing fall wheat.

Time of appearance of earliest shoots of same above ground.

Time of last snow on the ground.

The depth of snow on the ground on the last day of each winter month.

The time of migration of wild fowls and birds, the flights north and south.

The time of leafing and fall of leaves in deciduous forests.

The date of breaking up of ice in large rivers; in bays.

The date of greatest rise and lowest water in important streams.

Voluntary observers are requested to include in their monthly reports all reliable information relative to the destruction of life and property, coming to their knowledge, due to the storms, classifying it, as far as possible, as indicated in the following, viz:

Date of storm, nature of storm (tornado, northeast gale, etc.), section of country traversed by the storm; number and names of persons killed; number and names of persons injured; number of houses, barns and other buildings destroyed or damaged, with estimated amount of loss; estimated amount of damage to property; number of animals killed and estimated value.

A tornado has never been known in Wyoming, and from the physical conditions which produce them it is probable they never will be. Their origin is to the east of us. While our records show sometimes a high velocity of the wind, still there is hardly ever any damage produced by it, on account of the extreme lightness of the atmosphere, the pressure at Laramie being 11.3 pounds, against 14.7 pounds at sea level.

The wind moving at the rate of 36 miles per hour at Laramie has less than three-fourths the force or power of the wind moving at the same rate at the level of the sea.

INSTRUMENTS USED.

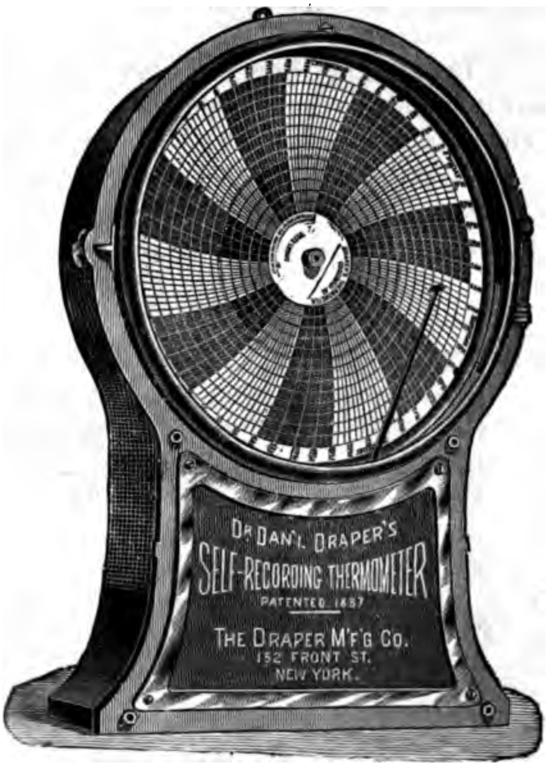
DR DAN'L DRAPER'S
SELF-RECORDING THERMOMETER
PATENTED 1887
THE DRAPER M'F'G CO.
152 FRONT ST.
NEW YORK.

FIG. 1.—Draper's Self-Recording Thermometer.

This instrument records the temperature by means of clock-work, on large paper dials which are kept on file so that we can see the slight or sudden changes for every minute of the day. While its readings do not agree exactly with the thermometers, yet by comparing the self-registering with the observations taken by the other thermometers, we

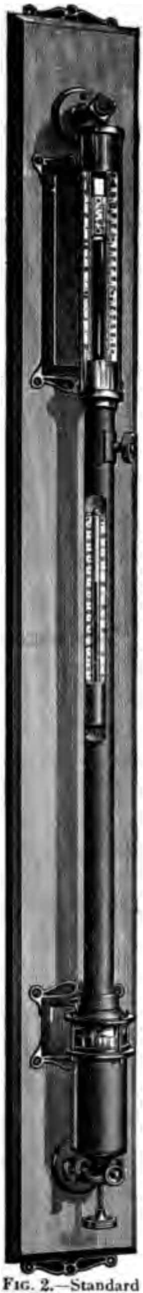

FIG. 2.—Standard Barometer.

can find within a degree Fahrenheit the temperature for any hour of the day for the last five years.

The readings from the Standard Barometer (**Fig. 2**) are taken twice each day, viz., at 7 a. m. and 7 p. m. The average monthly readings are found in Table IV.

Besides this barometer we have the Richards Self-Registering Aneroid Barometer.

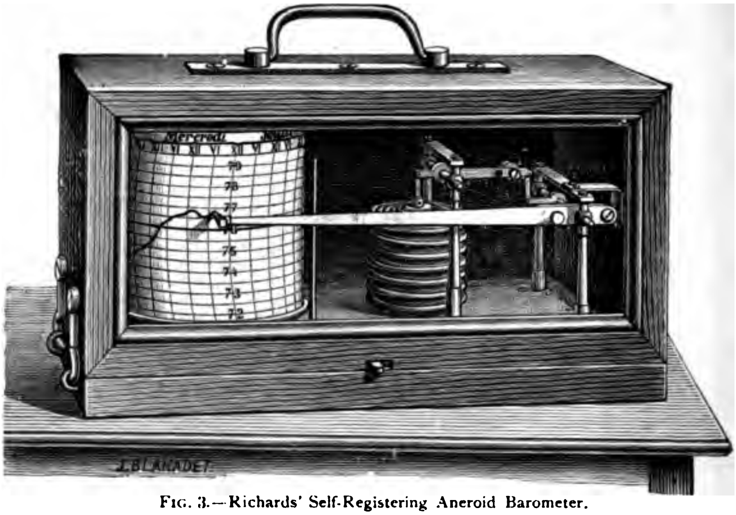

Fig. 3.—Richards' Self-Registering Aneroid Barometer.

While this instrument, like the Draper's Self-Recording Thermometer, is not as accurate as the standard instruments, yet it has the advantage of recording the barometric reading of every minute of the day, so that one can see just the time of any change; which, on being compared with the standard barometer, gives close approximate results.

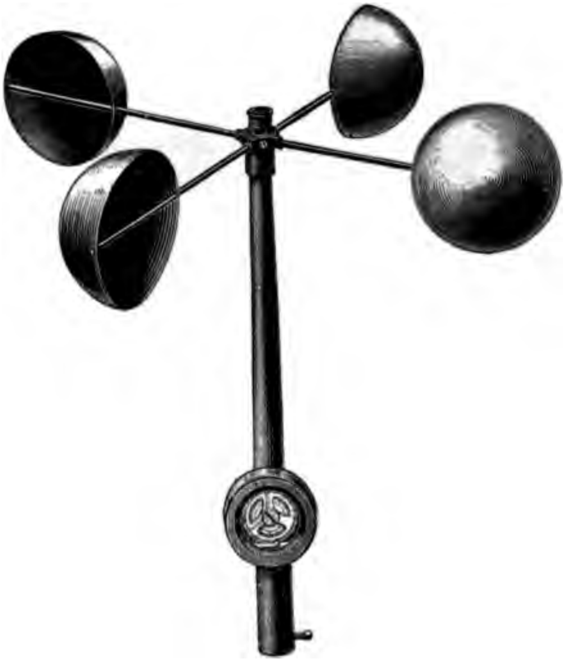

FIG. 4.—Robinson's. Anemometer.

This instrument is of such great importance that a more detailed account of it is given than of the others thus far mentioned.

The following description is taken from Bulletin No. 4 of this Station, on Meteorology:

"Robinson's Anemometer is an instrument designed to measure the number of miles and the velocity of the wind. The size of the cups and the length of the arms are such that three miles of wind passing causes the center of the cups to travel one mile. This ratio varies with the velocity of the wind. According to Greeley, at great velocities it is less than three to one, and more wind is registered than really blows. This is probably true at this place, where we have so much wind, though the error is not likely to be more than 15 or 20 per cent at any time. It is also possible that there is an error due to elevation, the air here being more rarefied and consequently exerting less pressure on the vanes; its amount could only be determined by experiment. It would tend, however, to counterbalance the former error. The vanes and crossbars are of aluminum, which gives lightness and durability. These are connected with a rod and endless screw to the cog wheels which turn the dial."

The anemometer and wind vane are on a steel tower 70 feet high, and 300 feet away from the University, connected by means of insulated copper wires with the self-registering apparatus, a description of which is as follows:

THE QUADRUPLE REGISTER.

This self-registering apparatus, made by Julien P. Friez, of Baltimore, is the most interesting instrument in the Meteorological Department. It consists principally of a fine eight-day clock that revolves a brass drum six inches long and five inches in diameter, around which a blank register is wound. As the name quadruple signifies, it is constructed to register four different measurements at once, viz.: The velocity of the wind; the direction, whether north, south, east or west; it will also record the percentage of sunshine and the amount of rainfall.

The necessary attachments for sunshine and rainfall have not been secured yet. We use it for the velocity and the direction of the wind, but hope in the near future to add the other two attachments. At present there are two automatic pens, worked by electricity, registering the velocity of the wind, also its direction for every minute of the twenty-four hours of the day. A blank register is placed upon the brass drum at noon each day. Thus there is recorded, on these records kept on file, a complete

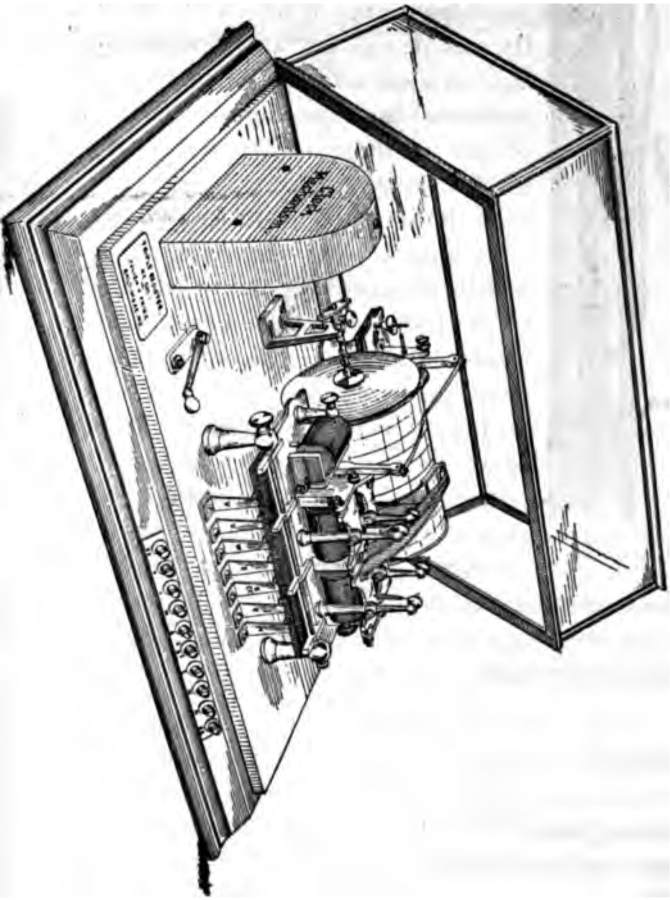

FIG. 5.—The Quadruple Register.

history as to the direction and velocity of the wind, as well as the total number of miles traveled by the wind.

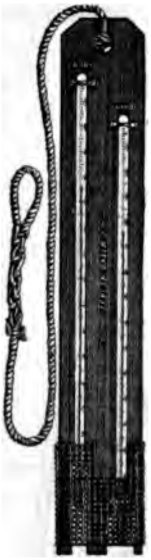

Fig. 6.—Sling Psychrometer.

Fig. 6 is a Sling Psychrometer, an instrument by means of which the relative humidity and dew-point are determined. It consists of a metallic frame upon which are two mercurial thermometers. The bulb of one of these is covered with a piece of linen fitting it closely. To read the instrument the linen-covered bulb is wet with clear water, and by means of the string attached to the framework the instrument is swung in the air. The evaporation from the covered bulb cools it, and its lowest reading is taken, at the same time reading the dry bulb thermometer. The difference between the two bulbs gives the means of determining the dew-point and saturation of the air of humidity, which are found in printed tables furnished by the United States Weather Bureau.

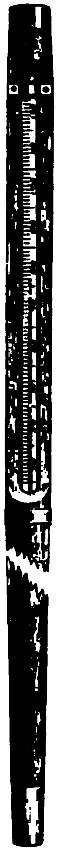

Fig. 7.—Soil Thermometer.

Fig. 7 is a Soil Thermometer. It is a mercurial thermometer encased in wood, adapted to different depths in the ground, viz., three inches, six inches, twelve inches, twenty-four inches, thirty-six inches and seventy-two inches. The temperatures recorded by these instruments are given in Table III. The lowest temperature of the deepest thermometer, six feet below the surface, was 34.3 ° F. on March 2, only about two degrees above the freezing point. a practical fact for plumbers to notice and keep their pipes at least six feet below the surface.

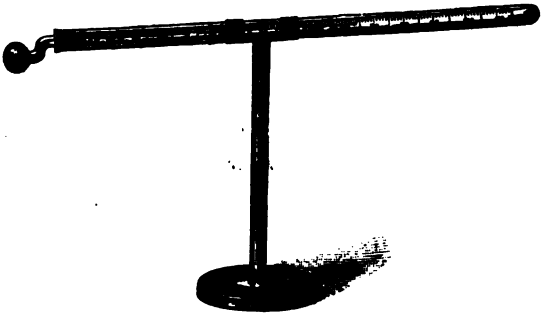

Fig. 8.—Terrestrial Thermometer.

Fig. 8 is a Terrestrial Thermometer. It is a minimum alcohol thermometer, the stem being enclosed for protection. It is kept about six inches from the ground. The radiation, or amount of heat lost by the earth, is shown by the difference of its reading and that of the minimum thermometer. For example, the coldest day of 1895 was on February 12, when the thermometer ten feet from the ground was —29.5 ° F.; the temperature registered by the terrestrial thermometer was —38.5 ° F., being nine degrees colder than ten feet above the ground. This difference is called terrestrial radiation.

Fig. 9 is a steel tower situated 300 feet from the main University building; it was erected for the support of the anemometer and the wind-vane. It is 70 feet high, thus lifting those important instruments above the counter currents and atmospheric interferences caused by the University tower. It is connected by wires with the Meteorological Department, where the direction and velocity of the wind are recorded.

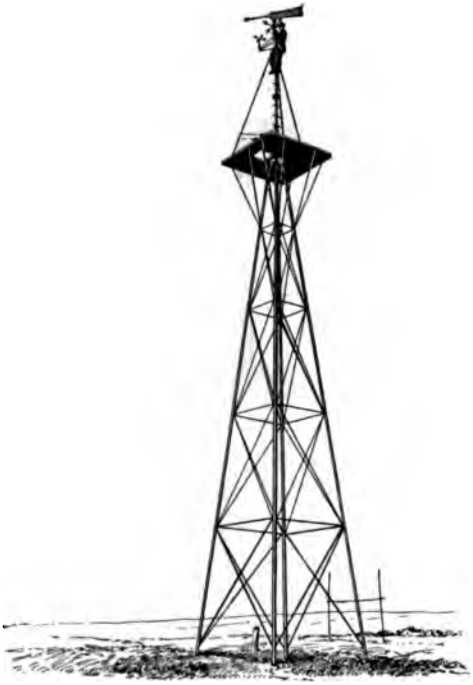

Fig. 9.—Steel Tower.

MAXIMUM AND MINIMUM THERMOMETERS.

These are self-registering. The maximum is a mercurial thermometer with a constriction in its tube near the base. It is mounted horizontally and the mercury which passes the small place in the tube does not go back into the bulb of the thermometer when it cools. The upper end of the column gives the reading of the warmest temperatures since the instrument was last set. The minimum is an alcohol thermometer with a small steel index in the alcohol in its tube. As it cools the surface tension of the alcohol pulls the index down, but as the temperature rises the alcohol goes up, leaving the top of the index in the position of its lowest point, which gives the reading of the lowest temperature since the instrument was last set.

EVAPORATION AT LARAMIE.

Evaporation from water surface is measured by means of a hook-gauge, measurements being taken every day that the water is not frozen. A tank of galvanized iron holding one cubic meter of water is used. Evaporation can not be accurately obtained during the winter months, there being only a little over six months of the year that water does not freeze so as to interfere with the record. For six months, from April 17 to October 22, it was 37.020 inches. During the time the water was not frozen the evaporation was as follows:

April 17 to 30	2.530 inches
May	7.334 inches
June	6.236 inches
July	7.294 inches
August	6.066 inches
September	4.944 inches
October	2.616 inches

OBSERVERS.

The observations are kept by the superintendents of the farms. (See the reports of the various farms.) Besides these are the the following voluntary observers, viz.: Mrs. C. M. Cheeney of Bates' Park (Freeland), Natrona County; Martin J. Gothberg, Dobin Springs, near Casper, Natrona County; Andrew Falconer, Hat Creek, Converse County; Lafayette Johnson, Little Horse Creek, Laramie County; A. E. Bridger, Sybille, Albany County. The observations at Laramie were made by the Assistant Meteorologist of the Experiment Station, Fred Nelson, who resigned in October, 1895. James P. Cowan was then elected assistant. Thanks are due to all these observers for the interest taken and the time spent in taking the observations and furnishing the records.

EXPLANATION OF THE TABLES.

The mean temperature is given from the maximum or highest and minimum or lowest temperature for each day. The daily range is the difference between these readings. In the relative humidity or per cent of saturation and dew-point tables, the computations are made from the readings of the sling psychrometer, which gives the dry and wet bulb temperatures. They have been computed from the tables in the report of the Chief Signal Observer for 1886, except where the difference between the wet and the dry bulbs is greater than those given, in which instances the tables of Guyot have been used, correcting for altitude in each case. The relative humidity is the per cent of moisture in the air, taking the whole amount the air could hold at the time as 100. The dew-point is the temperature at which this moisture would be precipitated should the air cool to that point. The barometer readings are corrected for temperature from Guyot's tables, each reading being reduced to 32° F. The terrestrial radiation, or the amount of heat the earth loses during the night, is given from the difference in the readings of the terrestrial thermometer, placed six inches above the ground, and the minimum thermometer. It will be noticed that it sometimes occurs that it is warmer near the ground than at the minimum thermometer kept ten feet above the ground. This usually happens on cloudy nights, or when the terrestrial is covered with snow, when little or no heat is lost by the earth. The soil temperatures are taken twice daily, at 7 a. m. and 7 p. m. The soil thermometers are located on the lawn at the University, and give the temperature of the ground. They are about 100 feet from ground that is irrigated, but not near enough to be influenced by the moisture therefrom. The air temperatures given in these tables are from the 7 a. m. and 7 p. m. readings.

A light frost occurred on July 13, 1891, and a damaging frost on August 22. Light frosts occurred on June 5, 6, 7 and 13, in 1892: a killing frost on Aug. 29. Killing frosts occurred on June 6 and August 16, 1893. There were light frosts on May 24 and 25, 1894. In 1895 a killing frost occurred on June 18th; hail on June 6th. July 17th and 31st; several light hailstorms in August.

Table I. TEMPERATURE. 1895.

PLACE.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Laramie	20.5	17.9	27.5	40.0	45.3	52.2	58.8	61.6	54.5	40.9	27.0	15.3	38.5
Lander	19.8	21.0	31.9	46.2	50.0	53.6	65.4	65.2	55.5	48.1	28.1	20.6	42.1
Saratoga	17.2	17.3	27.1	41.4	......	......	......	......	......	......	......	......	†25.7
Sheridan	14.5	13.8	29.4	47.6	51.2	56.6	63.7	63.4	54.3	45.3	29.1	26.8	41.3
Sundance	17.7	14.7	27.3	46.0	48.8	55.6	64.6	64.4	55.4	44.3	28.1	21.7	40.7
Wheatland	......	......	......	......	54.7	60.6	70.4	72.0	66.7	55.3	38.7	29.6	‡57.3
Freeland	......	......	......	41.2	47.2	53.5	60.3	62.7	54.0	39.5	24.8	18.6	‖44.6
Little Horse Creek	20.4	......	28.9	46.1	54.9	59.5	65.8	67.7	60.7	41.7	30.1	22.9	§45.3
*Dobin Springs	......	......	30.3	42.8	54.2	63.3	71.9	72.8	64.0	47.9	33.4	26.0	**50.7

*Thermometer broken. †For January, February, March and April. ‡From May to December. ‖Not including January, February and March §The average for all except February. **Average omitting January and February.

Table II. MONTHLY RANGE OF TEMPERATURE. 1895.

PLACE.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
Laramie	19.0	23.6	21.8	25.4	22.4	25.5	26.6	28.1	31.5	29.5	25.0	19.9	24.9
Lander	27.7	29.3	23.0	19.6	29.4	29.5	21.2	29.3	29.3	28.9	22.6	24.5	26.2
Saratoga	22.0	25.4	24.7	27.0	......	......	......	......	......	......	......	......	*24.8
Sheridan	25.3	27.8	24.3	31.9	27.9	24.2	33.5	32.1	32.5	35.4	27.3	32.1	29.4
Sundance	19.4	21.7	20.7	21.0	23.5	24.0	30.1	28.3	27.6	25.4	18.7	16.6	23.1
Wheatland	......	......	......	......	28.5	25.2	27.2	30.1	27.5	35.1	32.6	23.5	†28.7

*For January, February, March and April, †From April, 8 months.

Table III. Weekly Means of Soil Temperatures, Laramie, 1895.

WEEK ENDING	Air Temperature	3 Inches	6 Inches	12 Inches	24 Inches	36 Inches	72 Inches
January 5	18.2	22.6	23.0	24.7	28.7	32.2	39.9
12	21.1	23.0	24.2	25.8	27.7	31.6	38.7
19	25.0	27.2	27.8	28.5	30.0	32.0	38.0
26	15.7	21.2	23.9	26.3	29.5	31.8	37.5
February 2	7.5	15.9	17.6	20.5	26.1	29.6	36.7
9	16.1	24.2	24.9	24.4	26.7	29.0	35.9
16	—7.7	12.4	14.7	18.7	24.7	28.2	35.1
23	20.1	26.3	25.5	23.7	24.7	27.1	34.7
March 2	27.5	32.4	32.7	30.8	29.5	29.8	34.3
9	20.6	29.0	29.5	29.3	30.0	30.7	34.4
16	14.7	29.5	29.9	30.5	31.1	31.6	34.7
23	29.2	32.4	32.9	31.5	31.2	31.9	35.1
30	30.0	42.2	42.0	39.2	35.8	34.7	35.6
April 6	27.1	34.1	35.0	35.9	36.4	36.5	36.7
13	37.7	40.8	40.7	38.2	37.1	36.0	37.2
20	42.1	47.1	47.2	45.1	42.6	40.2	38.0
27	44.5	50.1	50.1	47.6	45.2	42.8	39.6
May 4	42.5	47.8	48.7	48.4	47.5	45.7	41.3
11	49.3	52 4	52.7	50.6	48.2	46.2	42.5
18	47.4	54.3	55.5	53.6	51.2	49.1	43.8
25	47.0	53.1	54.0	53.0	51.4	49.8	45.1
June 1	46.6	50.5	52.1	52.2	51.8	50.6	46.1
8	46.6	50.3	50.4	48.8	48.6	48.0	46.3
15	56.3	58.8	58.3	55.4	52.9	50.8	46.6
22	53.3	60.4	60.8	58.3	56.6	54.3	48.2
29	56.0	64.5	64.5	62.0	59.5	56.6	49.7
July 6	62.4	66.5	66.2	63.3	60.5	57.8	51.3
13	49.1	59.7	60.8	60.8	60.2	57.2	52.4
20	61.7	63.1	63.1	61.1	59.3	57.4	52.8
27	62.7	65.3	65.2	62.7	60.5	58.3	53.2
August 3	60.5	65.4	65.9	64.3	62.5	60.2	54.0
10	60.8	67.1	67.4	65.4	63.2	60.8	54.7
17	62.9	68.0	67.7	65.2	63.1	60.9	55.2
24	60.0	65.8	66.2	64.9	63.4	61.1	55.7
31	58.3	63.0	63.7	62.8	61.9	60.6	55.9
September 7	55.4	63.4	63.5	61.8	60.6	59.4	55.6
14	61.4	64.3	64.2	62.4	60.9	59.4	55.6
21	53.5	62.7	62.9	62.2	60.7	59.5	55.5
28	43.1	54.3	54.1	53.1	55.5	56.1	55.1
October 5	40.7	52.1	52.7	53.6	54.3	54.4	54.0
12	42.6	50.0	49.4	50.2	50.0	51.1	52.8
19	30.3	48.9	49.4	49.6	49.8	50.2	51.5
26	32.5	40.1	42.4	44.0	47.0	48.1	50.5
November 2	34.9	36.2	38.3	39.9	43.0	44.8	49.0
9	24.0	31.9	33.6	37.0	40.2	42.5	47.5
16	27.9	31.1	33.2	34.3	37.3	39.7	45.9
23	25.3	32.6	34.0	35.7	37.8	39.3	44.5
30	20.3	25.8	27.5	30.5	34.5	37.1	43.4
December 7	18.8	24.0	25.1	28.0	32.2	34.9	42.1
14	28.9	30.4	30.0	29.9	32.1	34.1	40.8
21	17.4	22.1	24.5	26.6	30.6	33.2	39.8
28	10.7	18.5	21.1	24.1	27.8	30.6	38.7
Summary	1968.4	2274.8	2310.7	2296.4	2313.6	2315.5	2339.2
Mean	37.9	43.7	44.4	44.2	44.5	44.5	45.0

Table IV. LARAMIE. 1895.

Month.	Relative Humidity.			Dew-Point.			Barometer.			Wind.			Terrestrial Radiation.		
	Highest	Lowest	Mean	Highest	Lowest	Mean	Highest	Lowest	Mean	Greatest Velocity	Miles	Direction	Highest	Lowest	Mean
January	95.5	39.8	62.8	25.4	−16.0	6.9	23.210	22.590	22.848	56 miles	10,380	SW	7.7	1.0	3.9
February	100 0	25.7	68.0	27.6	−29.5	5.7	23.254	32.756	22.985	44 "	8,507	SW	9.0	.8	4.4
March	100.0	24.5	59.4	32.7	−6.2	11.3	23.306	22.598	22.922	48 "	12,047	SW	8.0	.4	3.6
April	100.0	15.7	57.2	37.2	0	22.6	23.402	22.576	23.048	57 "	9,111	NW	5.8	0	2.8
May	100.0	15.8	55.5	41.2	15.0	28.9	23.370	22.468	23.014	40 "	10,222	NW	5.6	.2	2.8
June	100.0	20.7	55.1	49.8	13.0	35.3	23.272	22.911	23 137	40 "	8,511	SE	8.0	0	4.1
July	89 2	22.3	56.9	54.5	26.8	42.0	23.339	23.009	23.174	54 "	7,040	SW	9.0	.2	4.0
August	100.0	26 1	55.7	58.0	28.2	42.8	23.368	22.964	23.215	42 "	7,365	SE	8.7	.7	4.0
September	91.0	17.0	50.4	57.7	13.5	31.5	23.387	22.777	23.119	56 "	8,989	SW	8.0	1.9	5.5
October	89.8	20.7	60.2	63.0	6.0	25.7	23.351	22.921	23.167	36 "	6,917	SW	8.5	0	5.6
November	100.0	15.6	61.1	63.0	−24.5	16.3	23.277	22.682	23.004	48 "	8,043	SW	13.0	0	4.9
December	100.0	24.0	59.6	27.2	−15.0	7.9	23.301	22.535	22.960	48 "	11,000	SW	11.0	0	3.2
Summary			701.9			275.9			276.593		108,741				48.8
Mean			58.5			23.0			23.049		9,060.9	SW			4.07

Table V. PRECIPITATION. 1895.

Place.	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
Laramie	0.08	0.14	0.43	0.87	2.09	2.12	2.71	1.17	0.18	0.74	0.32	0.33	11.15
Lander	0.75	0.75	1.32	5.48	2.32	2.03	0.61	1.28	2.26	0.89	1.97	0.00	19.66
Saratoga	0.70	0.55	3.30	1.00	......	......	......	......	......	......	......	......	*5.55
Sheridan	1.60	0.90	0.85	2.25	1.88	3.19	0.57	1.44	1.19	0.57	0.95	0.25	15.64
Sundance	1.20	2.10	2.50	1.48	3.47	5.25	1.35	0.45	0.75	0.47	2.72	2.10	23.84
Wheatland	......	......	......	......	4.30	3.20	1.46	0.00	0.60	2.00	0.80	0.70	†13.06
Freeland	......	......	......	1.71	0.44	1.80	‖2.80	0.55	1.50	0.05	1.50	1.45	‡11.80
Dobin Springs	1.60	0.60	3.40	2.50	1.45	2.38	2.41	0.45	1.50	0.40	1.00	0.75	18.44
Little Horse Creek	0.02	0.05	0.13	3.60	1.38	2.48	1.87	0.54	1.90	0.00	0.25	0.00	12.22

*First four months. †Eight months, commencing with May. ‡Nine months, omitting January, February and March. ‖1 inch hail.

Summary for 1895.

Highest Temperature.

Laramie, 87°, July 27; Lander, 89°, July 26; Sheridan, 95°, August 15; Sundance, 94°, July 22 and 23; Wheatland, 101°, July 27.

Lowest Temperature.

Laramie, —30°, February 12; Lander, —26°, February 11; Sheridan, —38°, February 7; Sundance, —31°, February 7; Wheatland, (instrument broken); Saratoga, —35°, February 11.

Highest Monthly Range of Temperature.

Laramie, 31.5°, for September; Lander, 31.5°, June; Sheridan, 35.4°, October; Sundance, 25.4°, October; Wheatland, 35.1°, for October (only eight months reported.)

Lowest Monthly Range of Temperature.

Laramie, 19°, for January; Lander, 19.6°, for April; Sheridan, 24.2°, for June, also 24.3° in March; Sundance, 16.6°, in December; Wheatland (for eight months), 23.5°, in December.

The highest annual mean temperature was at Lander, 42.1°.

The lowest annual mean temperature was at Laramie, 38.5°.

The average annual mean temperature for the following four farms, Laramie, Lander, Sheridan and Sundance, was 40.7°.

The greatest annual precipitation was at Sundance, 23.84 inches.

The lowest annual precipitation was at Laramie, 11.15 inches.

The average precipitation for the four farms and Dobin Springs and Little Horse Creek was 16.84 inches.

Other Observations at Laramie.

Highest terrestrial radiation, 15.5°, November 27; lowest terrestrial radiation, 0.0°, April 5, 15, 26, June 3, October 4, November 17, 23, 25, and December 20.

Lowest relative humidity, 15.7, on April 25; mean relative humidity for the year, 58.5.

The highest dew-point was 54.5°, on July 30; the lowest on December 29, —15°; the mean dew-point for the year was 23°.

The greatest monthly evaporation was in July, 7.294 inches; total evaporation for six months from April 17 to October 22, was 37.020 inches.

The highest barometer was on September 28, 23.388; the lowest on December 15, 22.543; mean barometer for the year, 23.049.

The prevailing direction of the wind was southwest. The greatest number of miles traveled in one month was 12.047, in March; the greatest number of miles in one day, 547, November 26.

Meteorological Notes, 1891-1896.

These notes are made from the records kept for the last five years at the various Experiment Farms.

LARAMIE.

The instruments are kept at the University. The farm is situated nearly three miles southwest, at about the same altitude.

The dome of the University is in latitude 41° 18′ 37.09″ North, and in longitude 105° 34′ 53.75″ West from Greenwich. It is 30.260 miles west of the 105th meridian. The longitude from Greenwich expressed in time is 7 hours, 2 minutes, 19.58 seconds. Difference in time between Greenwich and Washington is 5 hours, 8 minutes, 12.04 seconds. Difference between Washington and the University, 1 hour, 54 minutes and 7.54 seconds. The length of a degree of longitude in latitude 41° 19′ is 52.030 miles. The altitude of Laramie where Grand Avenue crosses the Union Pacific railroad is 7,149 feet above sea level.

The above accurate data was furnished by Hon. Wm. O. Owen, State Auditor, who was for many years County Surveyor of Albany County.

Two students of the University, L. E. Morris and Harry Houston, run check levels from the point mentioned on the Union Pacific railroad to the room in which the meteorological instruments are kept, and found it to be

38.75 feet above the railroad, making the true altitude of the room 7,187.75 feet.

Temperature.

For the last six months of 1891 the highest temperature at Laramie was 82.5°, on August 13; the warmest day for twenty-four hours was on August 5, mean, 67.4°. In 1892 the highest temperature was 86°, on August 14 and 16; the warmest day for twenty-fours was on July 20; mean, 71.2. In 1893 the highest temperature, 87.2°, occurred on July 21. In 1894 the highest temperature was 87.6°, on July 11; the warmest day for twenty-four hours was 71.5°, on July 11. In 1895 the highest temperature was 87°, on July 27; the warmest day for twenty-four hours was 68.6°, on July 27.

The lowest temperature at Laramie for the last six months of 1891 was —13°, on December 7. The coldest day for twenty-four hours was 3.7°, on December 25. In 1892 the lowest temperature was —29°, on January 11; the coldest day for twenty-four hours was also on January 11, —13.5°. In 1893 the lowest temperature was —9.2°, on February 27. In 1894 the lowest temperature was —27°, on December 28; the coldest day for twenty-four hours was —10.5°, on December 27. In 1895 the lowest temperature was —29.5°, on February 12; the coldest day for twenty-four hours was —21.5°, on February 12.

The mean annual temperature for 1891 was 40.9°; for 1892, 40.5°; for 1893, 40.6°; for 1894, 39.9°; for 1895, 38.5°. The average for five years was 40.08°.

The greatest daily range of temperature for Laramie in 1891, from July to December, was 50°, on August 7; in 1892 it was 44°, on October 3; in 1893 it was 49°, on January 24; in 1894 it was 49°, on January 24; in 1895 it was 45.5°, on February 16.

The lowest daily range from July to December in 1891 was 4.2°, on December 28; the mean daily range for the same time was 26.4°. In 1892 the lowest was 1.3°, on December 16; the mean daily range for the year was 23.9°. In 1893 it was 0.5°, on March 20. In 1894 it was 0.5°, on March 20. In 1895 it was 0.5°, on May 30.

By studying the range of temperature of any particular region we can form a good idea of its climatic condition. Observe above that there is sometimes as much as 50° difference between night and day; for example, on August 7, 1891. The average daily range for August, 1892, was 32°, showing that we have warm days and quite cool nights, which condition prevailing throughout the year brings down the average temperature to about 40° F.

The average maximum temperature for August, 1892, was 77.9°.

The average minimum temperature for the same time was 45.7°

The mean relative humidity from July to December, 1891, was 66.4; for 1892 it was 63.7; for 1893 it was 56.9; for 1894 it was 56.4; for 1896 it was 58.5.

The lowest relative humidity for 1892 was 13.3, on November 14; for 1893 it was 9.2, on January 8; for 1894 it was 10.6, on June 26; for 1895 it was 15.7, on April 25.

The mean dew-point for the last six months of 1891 was 30.1°; for 1892 it was 24.6°; for 1893 it was 21.7°; for 1894 it was 22.5°; for 1895 it was 23°.

The highest dew-point for 1892 was 55.5°, on June 22; for 1893 it was 54.5°, on July 26; for 1894 it was 56.2°, on July 3; for 1895 it was 54.5°, on July 30.

The lowest dew-point for 1892 was —21°, on January 11; for 1893 it was —16°, on December 16; for 1894 it was —23°, on December 28; for 1895 it was —15°, on December 29.

Evaporation.

The evaporation from July 22 to November 11, 1891, was 22.7 inches; in 1892, from May 24 to October 10, it was 34.91 inches; in 1893, from May to October, it was 37.525 inches; in 1894, from April 26 to October 27, it was 37.166 inces; in 1895, from April 17 to October 22, it was 37.020 inches.

The greatest monthly evaporation for the last six months of 1891 was 8.59 inches for August; in 1892 it it was 9.19 inches for July; in 1893 it was 9.35 inches for July; in 1894 it was 7.492 inches for June; in 1895 it was 7.334 inches for May; July was next, nearly the same, 7.294.

Barometric Height.

The mean barometer for the last four months of 1891 was 22.969; for 1892 it was 23.041; for 1893 it was 23.196 (the record was not complete); for 1894 it was 23.054; for 1895 it was 23.049.

The highest barometer for 1892 was 23.382 inches on October 26; for 1893 it was 23.418 on September 1; for 1894 it was 23.389 on July 1; for 1895 it was 23.387 on September 28.

Lowest barometer for 1892, April 3, 22.466 inches; for 1893, January 31, 22.501 inches: in 1894, on January

3, 22.531 inches; in 1895, December 15, 22.543 inches. Average for past four years, 23.075 inches.

Terrestrial Radiation.

Mean terrestrial radiation for the last six months of 1891 was 2.9° ; for the whole year of 1892 it was 3.2° ; for the year 1893 it was 3.5° ; for 1894 it was 4.4° for 1895 it was 4.07°.

The highest terrestrial radiation for 1892 was 9.1° on December 22; for 1893 it was 11° on September 8; for 1894 it was 11° on September 27; in 1895 it was 15.5° on November 27.

Wind.

The greatest number of miles traveled by the wind in one month for each of the last four years was as follows: For 1892, in April, 12,918.3; for 1893, in March, 12,500 miles; for 1894, in March, 12,265 miles; for 1895, in March, 12,047 miles. The average for March for the past four years, 12,432 miles.

The greatest number of miles traveled in one day in 1892 was on January 4, 980.1 miles; in 1893, March 12, 713 miles; in 1894, June 5, 918 miles; in 1895, November 26, 547 miles.

The greatest velocity per hour for the last six months of 1891 was on November 10, 65 miles per hour; for the the year 1892 it was in March, 87.2 miles per hour; for 1893, May 25, 68 miles per hour; for 1894, 56 miles per hour, on April 15, also on June 6; for 1895 it was 54 miles, on September 21.

Precipitation.

The highest monthly precipitation for the year 1891 was 2.92 inches in May; in 1892, 3.97 inches in June;

for 1893 it was 0.54 inches, in June; for 1894 it was 1.60 inches, in June; for 1895 it was 2.71 inches in July.

The greatest percipitation for one single storm in 1892 was 3.90 inches melted snow, October 11 and 12. There was also a heavy snow storm June 4 and 5, 1892, giving 3.31 inches melted snow. In 1893, June 4, 0.47 inches. In 1894, April 18, 1 inch melted snow. In 1895, May 31, 0.98 inches.

The annual precipitation for 1891 was 13.92 inches; for 1892 it was 12.73 inches; In 1893 it was 3.84 inches; for 1894 it was 8.63 inches; in 1895 it was 11.15 inches.

The average annual precipitation for the last five years was 9.85 inches. This low average was due to the very small rain fall of 1893, the amount being 3.84 inches, the smallest on record for this region. During the year 1894 it was also very small, viz., 7.63 inches. The average percipitation from the records, three miles south, at Fort Sanders, for nine years from 1869 to 1878, was 12.92 inches. The average for 1891, 1892 and 1895 is 12.60 inches.

Soil Temperatures.

The following are the mean soil temperatures for the past four years and a half: July 5, 1891, to January 2, 1892, three inches, 44.6°; six inches, 48.5°; twelve inches, 49.8°; twenty-four inches, 50.4°; thirty-six inches, 48.6°; seventy-two inches, 51.7°.

In 1892 the air temperature near the ground was 38.4°; three inches in the ground, 42.7°; six inches 44.5°; twelve inches, 44.9°; twenty-four inches, 44.7°; thirty-six inches, 46.1°; seventy-two inches, 45.7°.

In 1893, air, 40.8°; three inches, 43.1°: six inches, 45.3 ° ; twelve inches, 45.1 ° ; twenty-four inches, 44.8 ° ; thirty-six inches, 45.0 ° ; seventy-two inches, 45.3 °.

In 1894, air, 39.1 ° ; three inches, 44.5 ° ; six inches, 45.8 ° ; twelve inches, 45.8 ° ; twentw-four inches 45.5 ° ; thirty-six inches, 45.5 ° ; seventy-two inches, 45.7 °.

In 1895, air, 37.9 ° ; three inches, 43.7 ° ; six inches, 44.4 ° ; twelve inches, 44.2 ° ; twenty-four inches, 44.5 ° ; thirty-six inches, 44.5 ° ; seventy-two inches, 45.0 °.

The greatest difference between the three-inch thermometer for four years was 1.8 ° ; for the six-inch was 1.4 ° ; the twelve-inch, 1.6 ° ; the twenty-four-inch 1 ° ; the thirty-six-inch, 1.6 ° ; the seventy-two-inch, only 0.7 °

Frosts.

In 1891 there was a light frost July 13. An injuring frost on August 22. In 1892 light frosts June 5, 6, 7 and 13. Killing frost August 29. In 1893, killing frosts June 6 and August 16. In 1894 light frost May 24 and 25. In 1895, on June 18, killing frost.

LANDER.

The Lander farm is situated in latitude about 42° 50′ North and 108° 45′ West longitude. Altitude, 5,500 feet.

The records have been kept and faithfully reported from the beginning by J. S. Meyer, superintendent of the farm.

This section is protected by surrounding hills and mountains, and the climate is quite favorable for agriculture under irrigation.

General Summary for the Past Five Years.

The highest temperature for last six months of 1891 was in August and September, 87°. The mean temperature for July was 63.5°; August, 66.1°, and September, 58.4°. In 1892 the highest was 92°, in August; the warmest day for 24 hours was 79°, August 15. In 1893 it was 94° on July 19; the warmest day for 24 hours was 78.5°, on July 18. In 1894, July 10, it was 94°; the warmest day for 24 hours was 71°, on July 9 and 10. In 1895, July 26, it was 89°; the warmest day for 24 hours was 84°, July 26.

The lowest temperature for the last six months of 1891 was —19° in December. In 1892 the coldest was —26°, on Jannary 11; the coldest for 24 hours was —8° on the same day, January 11. In 1893, February 14 was the coldest, —10° below; the coldest for 24 hours was 6°, February 14. In 1894, February 20, it was —24°; the coldest day for 24 hours was —5°, January 23. In 1895 February 11 was the coldest, —26°; the coldest day for 24 hours was —10, February 11.

The mean annual temperature for the last four and one-half years was as follows: The last six months of 1891 the average was 49.3°; the average for 1892 was 44.8°; for 1893 it was 44.3°; for 1894 it was 43.4°; in 1895 it was 42.1°; general average, 43.7°.

The greatest daily range of temperature for the last six months of 1891 was 50°, on December 8; for 1892 it was 57°, on December 22; for 1893 it was 45°, on January 26; in 1894 it was 48°, on September 16; in 1895 it was 49°, on September 16.

The mean daily range for 1892 was 27.5 °; for 1893 it was 24.7 °; for 1894 it was 27.8 °; for 1895 it was 26.2 °; the average for four years was 26.55 °.

Lowest relative humidity for 1892 was 12.8, on June 8th.

The highest dew-point for 1892 was 62.1 °, August 9. Lowest dew-point, —12 °, November 7.

Precipitation.

The precipitation for the last six months of 1891 was 4.23 inches. Total for 1892 was 11.94 inches. The greatest monthly precipitation was in April, 4.89 inches. The greatest precipitation during one single storm for 1892 was 1.91 inches, July 7. The total precipitation for 1893 was 11.62 inches; for 1894 it was 10.72 inches; for 1895 it was 19.66 inches. The average for the past four years was 13.49 inches.

Frosts.

There were rather heavy frosts on June 4 and 13, 1892, a light frost on August 28 and killing frosts on October 12 and 14. In 1893 there were killing frosts on May 24, 25, 26 and 27, and September 22 and 23. In 1895, killing frosts June 17 and 18, and September 7, 21, 22, 23, 24 and 29.

SARATOGA.

Saratoga is situated in latitude about 41° 28′ and longitude 107° 5′. Altitude about 6,800 feet. Being located in a broad valley, and so near the same latitude and altitude as Laramie, the climatic conditions are quite similar.

The records were kept by the Superintendent of the farm, J. D. Parker, from the beginning of the work in 1891 until June, 1895, the experiments having then stopped on the farm on account of the lack of water.

General Summary for Four Years.

The highest temperature for the last six months of 1891 was 93°, on August 12. July and August had the highest mean, each 66.6°. In 1892 the highest was 92° on August 2 and 3; the warmest day for twenty-four hours was on July 24, viz., 72.5°. In 1893 the highest temperature was on July 21, 89°; the warmest day for twenty-four hours was 70.5°, on July 9. In 1894 the highest temperature was 88°, on July 10; the warmest day for twenty-four hours was 72.5°, on July 10.

The lowest temperature for the last six months of 1891 was —15°, on December 25. For 1892 it was —26°, on December 16 and 17; the coldest day for twenty-four hours was —6°, on December 17. The lowest temperature for 1893 was —13°, on February 13; the coldest for twenty-four hours was 5°, on February 13. The lowest temperature for 1894 was —29°, on December 27; the coldest for twenty-four hours was —10°, on December 27.

The following is the average temperature for each of the last four years: The last six months of 1891 the average was 45.4°; the average for 1892 was 41.6°; for 1893, it was 39.3°; for 1894 it was 40.3°. The general average for 1892, 1893 and 1894 was 40.4°.

The greatest daily range for the last six months of 1891 was 56°, on October 18; for 1892 it was 53°, on

June 1; for 1893 it was 46°, on June 19; for 1894 it was 66°, on November 15.

The lowest daily range for 1891 (six months) was 5° on December 2: for 1892 it was 2°, on January 13; for 1893 it was 5°, on April 25; for 1894 it was 3°, on December 24.

The mean daily range for 1892 was 29°; for 1893 it was 27.1°; in 1894 it was 29°. The mean daily range for 1892, 1893 and 1894 was 28.4°.

Precipitation.

The precipitation for the last six months of 1891 was 4.65 inches; the total for 1892 was 8.91 inches; for 1893 it was 14.52 inches; for 1894 it was 12.73 inches. The average for 1892, 1893 and 1894 was 12.05 inches.

The greatest precipitation for one single storm in 1892 was 1.61 inches on October 11 and 12; in 1893, 1.01 inches on June 2; in 1894, 1.11 inches on March 19. In 1895, March 29 and 30, the heaviest snow-storm for years, 24 inches. Observations stopped in June, 1895.

SHERIDAN.

Sheridan is situated in about 44° 48′ latitude, and 106° 57′ longitude. Altitude, 3,750 feet. It is the most northern part of the State from which we have reports of the weather.

The observations were reported by James A. Becker up to 1893; since then by John F. Lewis, Superintendent of the Experiment Farm.

The comparatively low altitude compensates in a great measure for the latitude. It is subject to greater extremes of heat and cold than any of the other farms. It is but a few miles from the Montana line. The growing season is comparatively long, and the agricultural possibilities very good.

A General Summary for the Last Four Years and a Half.

The warmest temperature observed for the last six months of 1891 was 90°, in August. The mean temperature for August was 65.3°. In 1892 the highest temperature was 89°, on August 24 and 31; the warmest day for twenty-four hours was 80.5°, on August 14. In 1893 the highest temperature was 102°, on July 20; the warmest day for twenty-four hours was 81.5°, on July 23. In 1894 the highest temperature was 96°, on August 27; the warmest day for twenty-four hours was 75°, on July 30. In 1895 the highest temperature was 94°, on July 2, 24 and 27; the warmest day for twenty-four hours was 72.5°, on August 2 and 13.

The lowest temperature for the last six months of 1891 was —24°, on November 16. For 1892 it was —46°, on January 11; the coldest for twenty-four hours was —22.5°, on January 11. For 1893 the lowest temperature was —45°, on February 1; the coldest for twenty-four hours was —27.5°, on January 31. For 1894 the lowest temperature was —36°, on January 24; the coldest for twenty-four hours was —19.5°, on January 23. For 1895 the lowest temperature was —38°, on February 7; the coldest for twenty-four hours was —17.5°, on February 7.

The following is a list of the mean temperatures for the last four years, some of the records for the last six months of 1891 having been lost: The average for 1892 was 41.3°; for 1893 it was 41.7°; for 1894 it was 42.8°; for 1895 it was 41.3°. The mean of the annual temperatures for the last four years was 41.5°.

The record showing the greatest daily range for the last six months of 1891 is not complete. For 1892 it was 55°, on October 4; for 1893 it was 55°, on October 21; for 1894 it was 62°, on October 16; for 1895 it was 67° on January 4.

The lowest daily range for 1892 was 1°, on November 24; for 1893, 0°, on April 29 and November 17; for 1894 it was 3°, on March 3 and 20 and November 18; for 1895 it was 2°, on June 2.

The mean daily range for 1892 was 28°; for 1893 it was 28.5°; for 1894 it was 30°; for 1895 it was 29.4°. The average for the four years was 28.97°.

Precipitation.

The precipitation for the last six months of 1891 was 5.04 inches; for 1892 it was 16.26 inches; for 1893 it was 12.60 inches; for 1894 it was 12.49 inches; for 1895 it was 15.64 inches.

The greatest monthly precipitation for 1892 was 3.29 inches in June; for 1893 it was 3.40 inches in May; for 1894 it was 3.15 inches in March; for 1895 it was 2.25 inches in April.

The greatest precipitation during one single storm in 1892 was 1.56 inches, October 11; in 1893 it was 1.76 inches, May 20; in 1894 it was 0.53 inches on April 7; in 1895 it was 0.95 inches on June 1.

Frosts.

Light frosts occurred in 1892 on May 13, 20 and 21; killing frosts May 2 to 6, and September 11.

In 1893, killing frosts May 27 and September 23.

In 1894, hail and snow on April 18.

In 1895, September 19 and 20, heavy snow; ice two inches thick; August 30, hail did some damage; several light frosts in June; killing frosts May 11, 16 and 29.

SUNDANCE.

Sundance is situated in latitude about 44° 24′ and longitude 104° 22′. Altitude about 4,750 feet.

The observations were reported at first, up to 1894, by Thomas A. Dunn, superintendent of the farm, but since then by the present superintendent, A. E. Hoyt.

The comparatively low altitude and the protection from mountains, together with the highest annual precipitation in the State, render the climate mild and the season of growth long.

It is the only farm of the Experiment Station where crops, generally, are matured without irrigation.

Notice further on the comparatively high precipitation for the past four years.

General Summary for the Past Four Years.

The highest temperature for the last six months of 1891 was 96°, on August 6; the mean for August was 63.5. In 1892 the highest temperature was 98°, on August 15; the warmest day for twenty-four hours was

77.8 °, on August 12. In 1893 the highest temperature was 96 °, on July 22 and August 6; the warmest day for twenty-four hours was 79 °, on July 11 and 22. In 1894 the highest temperature was 94 °, on July 30; the warmest day for twenty-four hours was 79.5 °, on August 21. In 1895 the highest temperature was 94 °, on July 12; the warmest day for twenty-four hours was 77 °, on August 4.

The lowest temperature for the last six months of 1891 was —10.5 °, on November 16. In 1892 the lowest temperature was —26 °, on January 18; the coldest day for twenty-four hours was —15 °, on January 10. In 1893 the lowest temperature was —31.5 °, on January 31; the coldest day for twenty-four hours was —14 °, on February 7. In 1894 the lowest temperature was —28 °, on January 23; the coldest day for twenty-four hours was —23.5 °, on January 23. In 1895 the lowest temperature was —31 °, on February 7; the coldest day for twenty-four hours was —10.5, on February 7.

The average temperature for 1892 was 41.2 °; for 1893 it was 40.6 °; for 1894 it was 42.3 °; for 1895 it was 40.7 °. The general average for the four years was 41.2 °.

The greatest daily range for the last six months of 1891 cannot be determined, as the instrument was broken. For 1892 it was 46 °, on September 26; for 1893 it was 49 °, on February 4; for 1894 it was 49 °, on March 28; for 1895 it was 45 °, on April 16 and July 24.

The lowest daily range for the last six months of 1891 (instrument broken); for 1892 it was 2 °, on May 2; for 1893 it was 2 °, on February 5, April 24 and May 24;

Frosts.

Light frosts occurred in 1892 on May 13, 20 and 21; killing frosts May 2 to 6, and September 11.

In 1893, killing frosts May 27 and September 23.

In 1894, hail and snow on April 18.

In 1895, September 19 and 20, heavy snow; ice two inches thick; August 30, hail did some damage; several light frosts in June; killing frosts May 11, 16 and 29.

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Notice further on the comparatively high precipitation for the past four years.

General Summary for the Past Four Years.

The highest temperature for the last six months of 1891 was 96°, on August 6; the mean for August was 63.5. In 1892 the highest temperature was 98°, on August 15; the warmest day for twenty-four hours was

77.8°, on August 12. In 1893 the highest temperature was 96°, on July 22 and August 6; the warmest day for twenty-four hours was 79°, on July 11 and 22. In 1894 the highest temperature was 94°, on July 30; the warmest day for twenty-four hours was 79.5°, on August 21. In 1895 the highest temperature was 94°, on July 12; the warmest day for twenty-four hours was 77°, on August 4.

The lowest temperature for the last six months of 1891 was —10.5°, on November 16. In 1892 the lowest temperature was —26°, on January 18; the coldest day for twenty-four hours was —15°, on January 10. In 1893 the lowest temperature was —31.5°, on January 31; the coldest day for twenty-four hours was —14°, on February 7. In 1894 the lowest temperature was —28°, on January 23; the coldest day for twenty-four hours was —23.5°, on January 23. In 1895 the lowest temperature was —31°, on February 7; the coldest day for twenty-four hours was —10.5, on February 7.

The average temperature for 1892 was 41.2°; for 1893 it was 40.6°; for 1894 it was 42.3°; for 1895 it was 40.7°. The general average for the four years was 41.2°.

The greatest daily range for the last six months of 1891 cannot be determined, as the instrument was broken. For 1892 it was 46°, on September 26; for 1893 it was 49°, on February 4; for 1894 it was 49°, on March 28; for 1895 it was 45°, on April 16 and July 24.

The lowest daily range for the last six months of 1891 (instrument broken); for 1892 it was 2°, on May 2; for 1893 it was 2°, on February 5, April 24 and May 24;

for 1894 it was 2°, on December 7; for 1895 it was 3°, on November 5.

The mean daily range for 1892 was 22.8°; for 1893 it was 24.9°; for 1894 it was 23.9°; for 1895 it was 23.1°.

Precipitation.

The precipitation for the last six months of 1891 was 11.70 inches; in 1892 it was 24.69 inches; in 1893 it was 16.56 inches; in 1894 it was 19.99 inches; in 1895 it was 23.84 inches. The general average for the past four years was 21.27 inches.

The greatest precipitation for one single storm for 1892 was 1.3 inches on January 31; for 1893 it was 4 inches melted snow on January 14; for 1894 it was 1.62 inches on May 16; for 1895 it was 2.01 inches on June 4

Frosts.

In 1892 light frost on June 5; killing frost September 11. In 1893, killing frosts May 22 and September 23. In 1894, light frosts every night in October. April 16, 1894, first hail of season.

WHEATLAND.

Wheatland is situated in about 42° latitude, and longitude 104° 54′ West. Its altitude is 4,700 feet, and being on the undulating plateau which extends from the Laramie range of mountains along the North Platte river into Nebraska, it is subject at times to the hot, dry winds of the plains, but they are not destructive. The season of growth is long, warm and favorable to crops, while the winters are not severe.

Most of the above description is taken from the Meteorological Bulletin of 1892. It is quite necessary to append the following note given in that Bulletin:

"The thermometers at Wheatland are not kept in a regular instrument house of the weather service, as at the other stations, but are located in a sheltered position, which would probably give little difference in temperature. However, this fact should be borne in mind in considering the above highest temperature, as it may be excessive."

The observations are reported by M. R. Johnston, superintendent of the Experiment Farm.

General Summary for the Last Four Years.

The highest temperature for the last six months of 1891 was 96°, on August 4; the warmest day for twenty-four hours was 78°, on August 6; the mean for August was 65.7°. In 1892 the highest temperature was 109°, on July 21; the warmest day for twenty-four hours was 88.5°, on July 21. For 1893 the highest temperature was 108°, on June 18; the warmest day for twenty-four hours was 84.5°, on July 12; it was 84° on June 18. For 1894 the highest temperature was 99°, on July 11; the warmest day for twenty-four hours was 81.5°, on July 10. For 1895 (the last eight months) the highest temperature was 101°, on July 27; the warmest day for twenty-four hours was 81.5° on August 11.

The lowest temperature for the last six months of 1891 was 0°, on November 17 and December 25; in

1892 it was —21°, on January 11; in 1893 it was —16° on January 28; in 1894 it was —22°, on January 26.

The coldest day for twenty-four hours in each year was as follows: In 1892, —12°, January 18; 1893, 6°, on November 30; 1894, 0°, on February 19; 1895 (for last eight months), 13.5°, on December 29.

The mean annual temperatures for the last four years were as follows: For the last six months of 1891 it was 48.35°; for 1892 it was 49.2°; for 1893 it was 48.8°; for 1894, (instruments broken late in 1894, which interfered with a complete record for 1894 and 1895.)

The greatest monthly range for the last six months of 1991 was 49°, on November 4; for 1892 it was 57°, on March 17; for 1893 it was 55°, on March 30; for 1894 it was 52°, on September 24; for 1895 (last eight months) it was 52°, on November 22.

The lowest daily range for the last six months of 1891 was 5°, on September 8 and December 30; for 1892 it was 1°, on January 16; for 1893 it was 0°, on April 17; for 1894 it was 1°, on April 30; for 1895 it was 7°, on December 10.

The mean daily range for 1892 was 29.4°; for 1893 it was 30.9; for 1894 (November and December missing) it was 29.9°; for 1895, record not complete.

Precipitation.

The precipitation for the last six months of 1891 was 5.54 inches; total for 1892 was 14.51 inches; for 1893 it was 6.42 inches; for 1894 it was 10.13 inches; for 1895 (for eight months, commencing with May) it was 13.06 inches.

The average for the three years, 1892, 1893 and 1894, was 10.35 inches.

The greatest precipitation during one single storm for 1892 was 1.30 inches on May 13; for 1893 it was 0.6 inches on October 11, and six inches snow on December 24, which is equivalent; for 1894 it was 1.25 inches on June 15 and July 3. For 1895 (eight months, commencing with May) it was 1.5 inches on June 2.

Frosts.

Light frosts in 1892 on June 6 and October 5; killing frost October 22. In 1893, light frost May 19 and killing frosts on September 23, 24 and 25. In 1894, light frost May 3.

1892 it was —21°, on January 11; in 1893 it was —16° on January 28; in 1894 it was —22°, on January 26.

The coldest day for twenty-four hours in each year was as follows: In 1892, —12°, January 18; 1893, 6°, on November 30; 1894, 0°, on February 19; 1895 (for last eight months), 13.5°, on December 29.

The mean annual temperatures for the last four years were as follows: For the last six months of 1891 it was 48.35°; for 1892 it was 49.2°; for 1893 it was 48.8°; for 1894, (instruments broken late in 1894, which interfered with a complete record for 1894 and 1895.)

The greatest monthly range for the last six months of 1991 was 49°, on November 4; for 1892 it was 57°, on March 17; for 1893 it was 55°, on March 30; for 1894 it was 52°, on September 24; for 1895 (last eight months) it was 52°, on November 22.

The lowest daily range for the last six months of 1891 was 5°, on September 8 and December 30; for 1892 it was 1°, on January 16; for 1893 it was 0°, on April 17; for 1894 it was 1°, on April 30; for 1895 it was 7°, on December 10.

The mean daily range for 1892 was 29.4°; for 1893 it was 30.9; for 1894 (November and December missing) it was 29.9°; for 1895, record not complete.

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The precipitation for the last six months of 1891 was 5.54 inches; total for 1892 was 14.51 inches; for 1893 it was 6.42 inches; for 1894 it was 10.13 inches; for 1895 (for eight months, commencing with May) it was 13.06 inches.

The average for the three years, 1892, 1893 and 1894, was 10.35 inches.

The greatest precipitation during one single storm for 1892 was 1.30 inches on May 13; for 1893 it was 0.6 inches on October 11, and six inches snow on December 24, which is equivalent; for 1894 it was 1.25 inches on June 15 and July 3. For 1895 (eight months, commencing with May) it was 1.5 inches on June 2.

Frosts.

Light frosts in 1892 on June 6 and October 5; killing frost October 22. In 1893, light frost May 19 and killing frosts on September 23, 24 and 25. In 1894, light frost May 3.

Notes.

The remarkable growth of cereals and all root-crops, by irrigation, at all the experiment farms, and at Sundance without irrigation, illustrates the adaptation of the climate to the growth of most of the farm products grown in northern states.

The farms can be grouped into pairs, and it is interesting to observe the parallelism between them. Laramie and Saratoga can be grouped together as the most southern points in an east and west line, they being about the same latitude and altitude ; consequently they are very similar in temperature and nearly the same in amount of precipitation, and in agricultural productions. Lander and Wheatland can be grouped on the same principle, as representing a line east and west across the middle of the state, Lander being very near the center, and Wheatland about 200 miles to the east. Their altitude as well as their agricultural possibilities are very nearly the same. Sheridan and Sundance are in an east and west line in the extreme northern part of the state, and in altitude are lower than either of the others. They have greater extremes of heat and cold than the other points, although their annual temperature is a little higher than that of Laramie and Saratoga, which are 250 miles further south ; but the temperature at Laramie and Saratoga is more uniform, on account of their more favorable latitude and higher altitude. They do not have the extremes of summer and winter as at the other farms.

To illustrate, let us take the extreme northern and southern farms, viz., the ones at Sheridan and at Laramie. The highest temperatures at Sheridan for the last four years were 89°, 102°, 96° and 94°. At Laramie for the same time, 86°, 87.2°, 87.6° and 87°. The coldest days at Sheridan for the same years were —46°, —45°, —36° and —38°; at Laramie for the same time, —29°, —9.2°, —27° and —29.5°. The annual temperature at Sheridan for the four years was as follows, viz. 41.3°, 40.6°, 42.8° and 40.7°; and at Laramie it was 40.5°, 40.6°, 39.9° and 38.5°. The average daily range at Sheridan for four years has been 29°; at Laramie 24.8°.

July has averaged the warmest at all the farms, and August has ranked second. The averages for June and September have been nearly the same. February has averaged the coldest at all the points; January ranked second and December third; but in 1892 January was the coldest December ranked second and February third. In 1893 February was the coldest December ranked second and January third. In 1894 February was the coldest January ranked second and December third. In 1895 February was the coldest January ranked second and December third.

The mean for each month at Laramie for the last four years was as follows, viz: January, 22°; February, 20°; March, 29°; April, 37.2°; May, 46.6°; June, 55.2°; July, 62.2°; August, 61.6°; September, 53.8°; October, 44.2°; November, 28°: December, 21°. When February has not been the coldest month the annual temperature has been comparatively warm.

The sunshine record has not been worked out for all the farms; but we will quote enough from Bulletin Number 10, 1892, to give a fair idea of the percentage of sunshine prevailing in Wyoming, taking the center of the state, the southern and the extreme northern points.

The sunshine at Lander indicates 13.6 per cent cloudy days; nearly 25 per cent clear; the remaining 61.4 per cent were partially cloudy, termed fair. September was the sunniest month, having no cloudy days, while May was the cloudiest, having 11 cloudy days.

Saratoga observations indicate 16.5 per cent cloudy days, with April the cloudiest month; 38.3 per cent clear days, with September the sunniest month; the remailing 45.2 per cent are fair.

Sheridan observations on the character of the day indicate 21 per cent cloudy days, with May the cloudiest month; 51.4 per cent clear days, with September the sunniest month; the remaining 27.6 per cent being fair.

This is sufficient to show the very high percentage of sunshine in the State of Wyoming.

UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 28.

MAY, 1896.

First Report on the Flora of Wyoming

BY THE BOTANIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

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ERRATA.

Page 83 read Erysimum for Erisymum.
Page 99 read Glycyrrhiza for Glyceria.
Page 170 read Monolepis for Monolepsis.
Page 199 read Cryptogramme for Chryptogramma.
Page 142 line 5 from bottom read Triassic for Tertiary.

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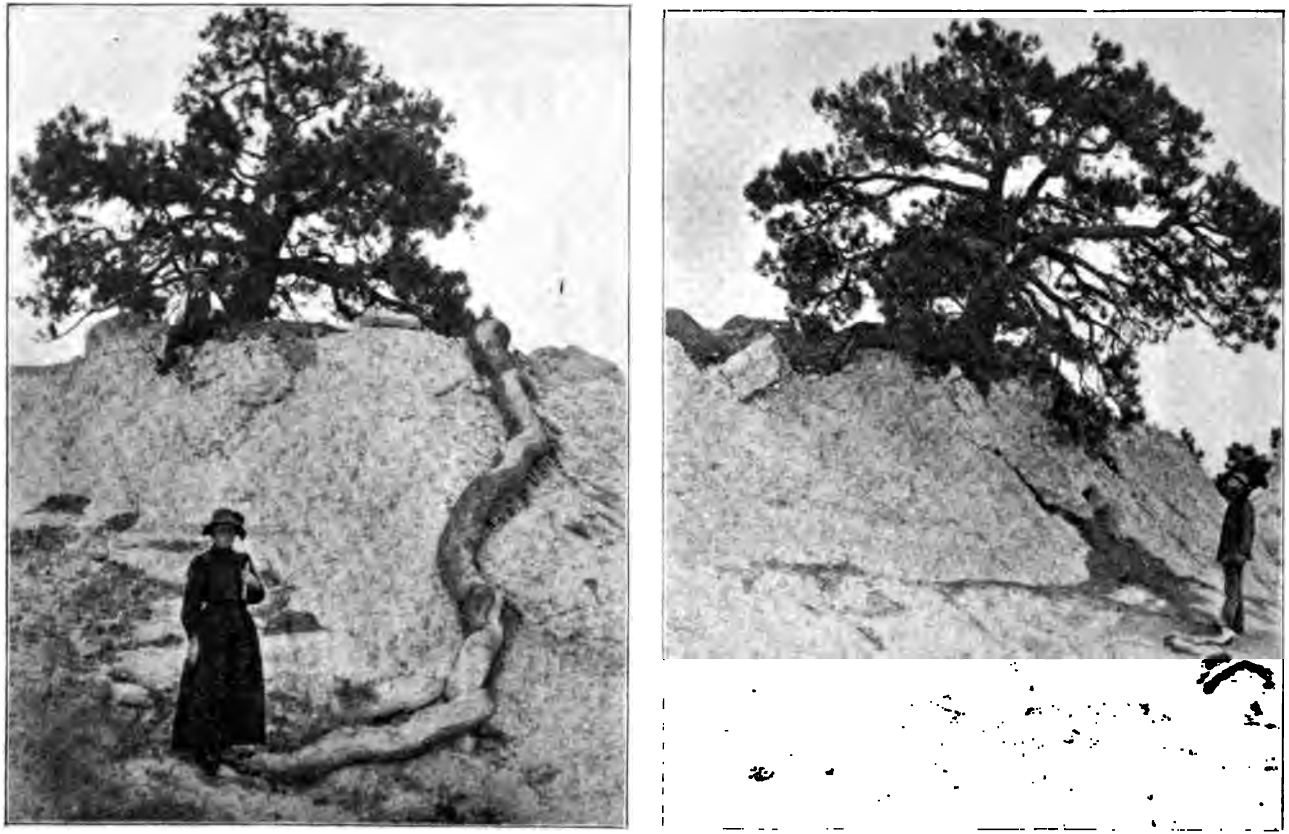

ROCKY MOUNTAIN YELLOW PINE.

Showing remarkable root development. Length from tree to point where root enters the ground, 45 feet. Sand Hills, 12 miles north of Lusk.
FROM PHOTOGRAPH BY PROF. B. C. BUFFUM

FIRST REPORT

—ON THE—

FLORA OF WYOMING.

BY AVEN NELSON.

INTRODUCTION.

Among the duties planned by and for the Botanist of the Experiment Station for the year 1894 were the following:

1. To study the Fungi affecting the ordinary farm crops and the best means of combatting the same.
2. To give attention to the weed question, with a view to finding effective methods for exterminating or preventing the spread of the more troublesome ones.
3. The building up of the herbarium.
4. The preparation of a report upon the flora of the state.

These all received attention to the extent of the time that could be spared from other imperative duties, such as those of the classroom and the routine work of the Station, but it was found necessary to continue the same subjects for 1895. During that time one phase of the first has had attention in Bulletin No. 21, "The Smut of Grains and Potato Scab;" the second in Bulletin No. 19, "Squrrel-Tail Grass (Fox-Tail)," our worst weed, and a Press Bulletin on the "Russian Thistle." The third has, of course, gone on incidentally with and preparatory to the fourth.

Although what has been done in the study of the flora of the state has cost no little time and labor yet the work seems but barely begun. The preparation of a full and reasonably inclusive report on the flora of a great state of nearly 100,000 square miles would be the work of years for a corps of men devoting their full time to the matter in hand, so one man with a full slate of college teaching and other Experiment Station duties, besides that of working up the flora, would lose courage were it not for the absorbing interest of the subject itself. Since to delay the report until it should be approximately complete would project it far into the future and might possibly result in its never being published, it has seemed advisable to publish the results thus far attained. As the work goes on and results accumulate, other reports may, from time to time, appear to record the additions.

COLLECTING TRIPS.

The basis for the following brief report and the catalogue of species rests mainly upon the collections made by the writer in 1894 and in 1895.

With one exception, as given below, no systematic work in collecting had previously been done. In 1892, Prof. B. C. Buffum, at that time acting botanist of the Station, spent the mid-summer months in the field collecting—primarily to secure for the University and the Station a collection of the native grasses and forage plants, an exhibit of which was to be made at the World's Fair at Chicago in 1893. Incidently much more was done, for a considerable amount of good material, other than grasses, must be put down to the credit of the expedition.

From this material were obtained the numbers which formed the nucleus of the present collection in our herbarium. Quite a large part of the state was covered during this trip, extending from Laramie, on the south, to Lander and the Wind River Mountains on the north-west, to Sheridan and the Big Horn Mountains on the north, and Sundance, Fort Laramie, and Wheatland on the east. How many numbers were collected, I am unable to state, as no field or collection numbers were made use of, but in the succeeding catalogue of plants those species where no collection number is noted,are generally to be credited to this expedition. In the Gramineæ and Cyperaceæ much the larger number of species are the result of this earlier expedition in which these groups received such thoroughgoing attention that in the later collecting trips it seemed advisable to concentrate attention upon the other Phanerogams.

It may be of interest to give briefly the history of the field work that furnished the material upon which this report rests.

1894.

During the continuance of the spring term of school, operations had to be confined to Laramie and adjacent territory. Mornings and evenings, holidays and Saturdays were used with all diligence. The most distant point reached was Table Mountain, about twenty miles to the east, and on the west the Laramie River served as boundary line. Limited as was the area covered and late as seasons are at this altitude, June 30 saw 300 numbers collected and stored in duplicate.

At the annual meeting of the Board of Trustees at the close of the school year, provision was made for an expedition to go into the field during the summer vacation, in the interest of the departments of geology and botany. Preparations for setting out were perfected as rapidly as possible, but it was not until July 7 that the start was made.

Beside the writer

THE PARTY

consisted of W. C. Knight, Professor of Geology in the University and Geologist of the Station; Mr. W. H. Reed, who furnished a large part of the outfit for the expedition; Mr. Geo. M. Cordiner, a student at the University, who accompanied the party as the writer's assistant.[*]

The expenses of the expedition were reduced to a minimum as they consisted of only the actual living expenses of the party in the field, plus the expense incident to securing the services of Mr. Reed, with his two teams and wagons and one saddle horse. The camp equipage consisted of all the necessary utensils, ample bedding, a tent, (which, owing to the perfect weather, was rarely used), a stock of groceries, besides the necessary apparatus for collecting in both botany and geology.

The botanist's outfit may be of interest and was as follows: Two ordinary-sized tin collecting cans, one of which had a number of small compartments at the end for diminutive and delicate objects, and one large tin vasculum—so large that it was always referred to as the "tin trunk." This was indispensable during the long mountain trips, when it was a desideratum to be able to bring back once for all a large amount of material. The most efficient instrument for uprooting plants, both on the plains and among the rocks in the mountains, was found to be a carpenter's strong chisel about three-fourths of an inch broad. Of course, a stout knife is not to be omitted from any collecting outfit.

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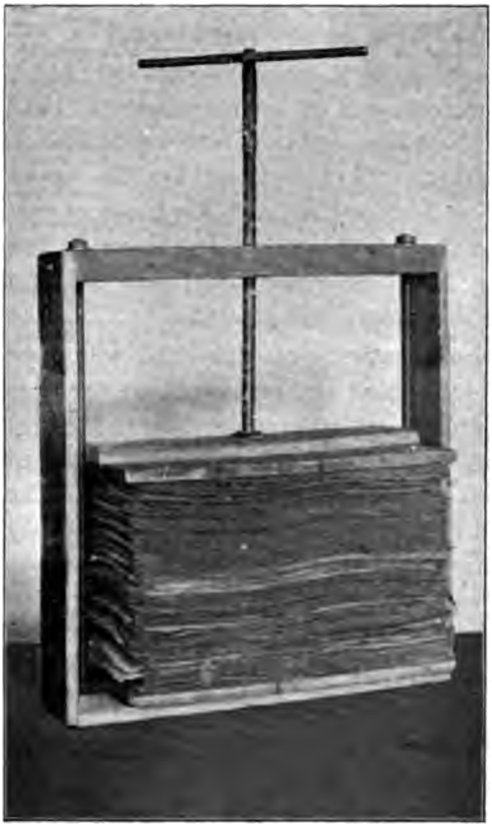
[*] It is with deep sorrow that I record the death of this noble young man. On March 14, 1895 he received fatal injuries during a fire in Laramie by being caught under the falling walls of a building from which he was helping to remove goods. While in the field he greatly endeared himself to the writer by his constant cheerfulness, his remarkable faithfulness to duty, his high efficiency and his moral worth.

Five plant presses were carried and found none too many at times, but at other times two would have been more than enough. Four of these were slat presses, the pressure in two being applied by straps and in the other two by cords as in the Acme press. The fifth, and most important one, was a screw-press and as it filled its purpose so admirably and proved so valuable an adjunct to the outfit, I add here a figure and brief description.



The base and the top bars are of oak, 2 x 4½ x 20 inches, the distance between them being 21 inches. They are united by one-half inch bolts so placed as to be eighteen inches apart. To keep the base and top in place when the pressure is relaxed strips of board ½x4½ inches are nailed to the ends. The floor to receive the package of plants is 12x18 inches, made by nailing pine board ⅞ inches thick crosswise of the base. The screw is a ¾-inch bolt with 15 threads to the inch, about 15 inches thread bearing. A square nut is sunk on the under side of the top bar and held in position by a piece of tin tacked over it, the tin having a circular hole in it large enough to admit the bolt. The follower is made of a strip of pine 1x5x18 inches, crosswise on which is nailed pine board ⅞ of an inch thick, making the surface 12x18 inches. On the upper face of the follower is fastened a small flat piece of iron with a sunk center to receive the end of the screw. The projecting end of the screw is made square, on which a removable handle with a square slot is used.

This homely, home-made press has the following advantages: It will furnish all the pressure that can possibly be desired; a large quantity of material can be handled at one time; coarse harsh plants can be forced into shape and held there; packages that have been in the screw press for twenty-four hours can be satisfactorily handled in the strap presses; moisture can be forced out so rapidly that by frequent change of driers the drying of the material may be considerably hastened; natural colors can be preserved in plants that by ordinary means would blacken; it furnishes a safe and convenient way for carrying the material while in press and in every way greatly facilitates the making of good flat specimens.

It was found that the capacity of this press is much greater than its dimensions would indicate. With a good quality of carpet felt for driers and single pressing sheets, cut to size (newspaper quality, unprinted), it was possible to do good and rapid work. Experience shows that more plants are spoiled by too little than by too much pressure.

ROUTE AND PRINCIPAL CAMPS.

The accompanying map will indicate the route in a general way but of course cannot show the miles and miles of ground covered in the vicinity of the various camps, nor the wide detours made on horseback during the days the party was traveling. At a rough guess, more than two-thirds of the time was spent on the road, as the distançe covered was upwards of 1,000 miles.

The days of travel were busy ones for the Botanist and his assistant, for at noon the collections of the morning were put into press, the driers on all the other recent material were changed, the damp driers thrown out on the hot sand and again collected. When camp was made for the night the afternoon collections were cared for, and, if they chanced to be heavy, the task was often completed by the campfire.

To enter into a detailed account of the journey would take up too much space, possibly to no purpose, so the following skeleton account must suffice: The route from Laramie took a north-east direction over the Laramie Hills past Grant, Wheatland and Uva postoffices to the Platte River, where camp was made July 10. After four days the camp was moved in turn to Hartville, a mining district, to Whalen Canon, and to the Mexican Mines. From this place a side trip was made by the Botanist and his assistant to Lusk. Camp was broken at the Mexican Mines on July 22, and the Platte River again reached at Orin Junction. From this place the river was followed to Bessemer, passing in turn Douglas, Glenrock and Casper. From Bessemer, Poison Spider Creek was followed to its head near Garfield Peak in the Rattlesnake Mountains. Camp for a day was made on Wallace Creek at the foot of the peak. Up to that date, July 29, this was the richest collecting ground so far encountered. The road from there to the Big Popo Agie river lay across a barren desert, whose few streams were dry and the occasional springs were mud holes, strongly impregnated with alkali.

The evening of July 30, caught us at Alkali Springs, a bog so densely impregnated with salt that only the almost famished horses could swallow a mouthful, and to one or two of the animals the draught came near proving fatal. There was no grass except an occasional stalk of salt-marsh grass--*Distichlis maritima* and *Triglochin maritima.* Thirsty as every member of the party was, after an all day's drive on the burning plain, not even coffee made from such water could be swallowed. Just at sunset a diminutive shower fell, and a dusty wagon sheet was called into service to catch the precious drops. As the little pool formed in the sagging center of the canvas what delicious draughts of nectar, thickened with the dust of many days, were dipped up with the old tin cups.

At four o'clock next morning, breakfastless, the party started for Beaver Creek, twelve miles distant. Breakfasting here where water was good and abundant, even the weakened horses were somewhat revived, though feed was still very scarce. Early in the afternoon the Big Popo Agie was reached by hard effort, and here three days were spent in camp to allow the sick and famished horses to recuperate. Water and grass were both abundant, and the horses soon showed the effect of better treatment.

August 3, the camp was moved to Lander, where a stop of twenty-four hours was made, after which the expedition proceeded to and up the Big Wind River. The route lay across the Shoshone Indian Reservation, one camp being made at Fort Washakie. It was found necessary to ford the Big Wind River thirteen times before Dubois postoffice was reached. This is the last outpost of civilization on the river and it is near this place that the trail over the Wind River Mountains through Union Pass leads off from the river.

The ascent through the pass was begun on August 10, the summit of the range being reached early on the 11th. A most varied and beautiful vegetation was present on every hand all the way up, and at the highest point in the pass, about 9,500 feet, the open parks among the Spruce groves were covered with the wildest profusion of flowers—a veritable botanist's paradise. Two full days were spent here, but that was far too short a time even though the days were considerably lengthened out by the cheerful evening and early morning campfires. Union Peak, with its snow banks, the moist, dense copses on its slopes and the small fertile valleys at its base rivalled each other in the richness of their treasures.

The days were slipping by and the stay could not be prolonged even here, so on the 14th we turned our faces toward the three Teton peaks, whose lofty summits, though yet a hundred miles away, were seen from our present point of vantage standing out against the pellucid sky like mighty spires, their seamed and snow-flecked faces shining with a radiance possible only in such an atmosphere as this. Over trails all but impassable, up hill and down dale, most laboriously we advanced and at last, on the 18th, camp was made in a Cottonwood grove on the banks of the Snake River in Jackson's Hole, near the foot of the Grand Teton.

Here some days were spent, during which an ascent of the Grand Teton was made. On the 20th three of us began the ascent. That night was spent on the shore of a small lake at about 9,500 feet. The next morning the more precipitous slopes were scaled, but at about 11,000 feet further progress was stopped by a frightful chasm which entirely cut off all communication with the spire-like summit that still towered above us. The descent was made more rapidly, and at nightfall on the 21st we were again in camp, loaded down with the collections of that and the preceding day.

This camp marked the most distant point reached by the expedition and on the afternoon of the 22nd the return journey was begun. The route lay up the Gros Ventre River, up Bacon Creek and over the divide separating it from Green River. On reaching Green River we camped for twenty-four hours, after which we proceeded to Cora postoffice on New Fork. At this point the route took a general south-east course, skirting the foot hills on the west of the Wind River range. The following streams were crossed in succession, viz: New Fork, Boulder Creek, East Fork, Silver, Willow, and Muddy Creeks, the Big and the Little Sandy. This brought us to South Pass City, the oldest mining camp in the Wind River Mountains, thirty miles south of Lander.

At this point, on September 1, the writer found it necessary to sever his connection with the expedition and return to Laramie. Mr. Cordiner remained with the party, and, although it was becoming late in the collecting season and the route lay through a rather barren region, made doubly so by the large flocks of sheep that had been driven over the range, yet a number of interesting species were secured, but unfortunately, most of this material was lost by the burning of a car in the Laramie yards the night of its arrival.

The writer was in the field eight weeks and two days and the other members of the party ten weeks and three days. During this extended trip 900 numbers were made (including some that were secured after the return to Laramie), which, added to the 300 collected during the spring, made 1,200 numbers for the season of 1894. These were all collected in duplicate, ten or more sheets of each number being prepared whenever the material could be procured. This omniverous collecting resulted in quite a percentage of duplicates, so that the actual number of species, not counting forms, was probably not much above 1,000.

1895.

In 1895 it was not found possible to spend even the whole of the vacation in the field but all available time was utilized during the entire season. Especial effort was directed toward procuring such species as were not secured in 1894, and it seemed wise to concentrate effort upon a much more limited area. To this end four expeditions were planned and carried out.

The first one left Laramie June 27, going to the east and working Pole Creek, Table Mountain and adjacent territory, 103 species being secured. The second left Laramie July 25, camp being established at Cummins

City, from which point the surrounding mountains and valleys were scoured and resulted in 123 numbers. The third expedition left for Laramie Peak, seventy-five miles distant, on August 3 and returned with 117 numbers. The fourth made two camps, one in the Centennial Valley and one at the La Plata Mines near the summit of the Medicine Bow (Snowy) range. From these two points adjacent territory was worked and yielded 192 species, many of them quite rare.

Besides the above species, there were collected at various times during the season 135 numbers, making a total for 1895 of 670 numbers. As these were all in duplicate, approximately in tens, the total number was near 6,700.

Of the 670 species about one-half are new as compared with the collections of 1894.

PLANT ZONES.

Recent writers have made much of plant zones as limited by given lines of elevation. There is, no doubt, considerable truth in the theory that fairly well marked belts are found, but I think it is possible to overestimate the importance as well as the distinctiveness of such zones. There are so many other factors that enter into the problem, such as moisture, soil and exposure that its solution becomes peculiarly difficult. The zones sink and rise in conformity as much with the configuration of the land, the absence or presence of arboreal vegetation, the character of the soil and the amount of moisture as in respect to the altitude. The monotony of the grassy plain gives place to a veritable garden if but a few clay hummocks or stony points and ravines interrupt its interminable length. Seven thousand feet with one exposure may produce a more truly Alpine flora than 9,000 feet with another.

Many species hold their own at almost all altitudes, and beginning with the lower altitudes, are successively in blossom throughout the season at higher and higher elevations. On the other hand, in given areas, a few certain plants are never met with except within a given range of elevation, but this given elevation differs for different parts of even the same state. It seems to be a a relative point depending as much upon the elevation of the surrounding country as upon the actual elevation above sea-level. It follows, therefore, that plant zones can only be established for a given area, as for instance, the Laramie Plains and the mountains that rise on either hand of it.

It has been well pointed out by Dr. Coville in his report on the "Botany of the Death Valley Expedition" that only certain plants can be taken to mark zonal lines. That only a few comply with the two characteristics of a good zonal plant, viz: "It shall have a definite termination at the borders of a zone or at lines substantially parallel thereto, but closer together." "That the belt of a zonal plant should be continuous." In any region I think this may be found true of a very small number of plants, but the large majority which have to be fitted into these zones will so overlap from zone to zone that no sharp distinctions can be drawn. Of course, between the lowest and the highest zone of a given area the characteristics are quite distinctive. These represent essentially different floras with as little in common as the vegetation of the plains and that of the adjacent mountains.

In this report it has not seemed wise to try to establish the vertical zones on account of the comparatively limited observations yet made within the wide borders of a great state. Rather something may be said of certain areas or characteristic regions.

THE PLAINS FLORA.

The regions referred to as plains differ greatly in respect to soil, rainfall and altitude. All are comparatively level tracts of land devoid of arboreal vegetation, if one excepts the occasional border of Cottonwoods on stream banks. In this report no mention can be made of the plains of the north-eastern, nor of the south-western parts of the state, for these regions are yet to be visited. It is, however, well known that both these regions differ materially from the rest of the state and from each other. The former, with a considerable rainfall and "gumbo" soil; the latter, sandy soil and a minimum of rain. Careful exploration in these two regions will add a large number of species to the list of the state.

The plains from which we have reports, meagre as yet, are the Laramie Plains; the plains lying east of the Laramie Mountains, and south of Lusk; those bordering on the Platte River, and those northward from the Platte through the center of the state to Lander; the plains adjacent to Wind River, and those of the upper part of the Green River valley; also the Gros Ventre valley, and Jackson's Hole. Through this latter mountain-enclosed, plateau-like plain flows Snake River.

All of these may again be classified, either as a whole or in part as: 1. Sandy, or gravelly plains. 2. Alkali plains.

To the first class belong those whose soil is comparatively free from alkali and whose characteristic shrub, when any is present, is the common sage brush (*Artemisia tridentata*). The characteristic undershrub is some form of *Bigelovia*, indiscriminately called White Sage, Rabbit Brush, Golden Rod, etc. Plains of this character may also be denominated grassy plains. The grasses on these of course vary greatly as to the species and the luxuriance of their growth. The following are among those of most frequent occurrence: *Agropyrum glaucum*, *A. violaceum*, *Bouteloua oligostachya*, and *B. racemosa*, *Buchloa dactyloides*, *Koeleria cristata*, one or two *Festucas* and several *Poas*. Along water courses and in boggy places, as well as in over-irrigated places, these are replaced or become mixed with many species of *Juncus*, *Scirpus* and *Carex*. Sometimes Foxtail (*Hordeum jubatum*) takes complete possession.

The second class.—The plains strongly impregnated with alkali (sodium carbonate or sodium sulphate), are in some instances nearly devoid of vegetation, but more usually we find several characteristic plants. If the alkali be sodium sulphate the characteristic shrub is *Sarcobatus vermiculatus*, the well-known Grease Wood. On sodium carbonate soil, this, if not replaced by, has mingled with it some form of *Atriplex*, usually *A. confertifolia*, frequently called White Sage. Other species of *Atriplex*, mostly annuals, are found in this character of soil, and if the soil is very strongly impregnated, as on the shores of salt-marshes and partially dried up alkali lakes, the various species of *Atriplex*, of *Sueda* and of *Salicornea* are often the only vegetation. In real alkali bogs we find *Distichlis maritima*, *Triglochin maritima* and *T. palustre* as the most characteristic vegetation.

The other areas may be spoken of as the foot-hills and the mountains.

FLORA OF THE FOOT-HILLS.

Two kinds of foot-hills must be recognized, viz: wooded and denuded. The denuded slopes are of course much dryer and a large part of the year devoid of all streams. These foot-hills, if stony or gravelly, are covered with *Cercocarpus parvifolius*, *Rhus tridentata*, *Amelanchier alnifolia*, *Purshia tridentata*—one or more in varying proportion. The intervening valleys, if soil is fertile, are usually covered with sage brush. The herbaceous vegetation in such foot-hills is so varied that no list can be offered here, but the following genera are well represented: *Draba*, *Astragalus*, *Potentilla*, *Actinella*, *Erigeron*, *Senecio*, *Krynitzkia*, *Phlox*, *Penstemon*, and *Poa*.

If the soil contains alkali, the above-mentioned shrubs give place to Grease Wood, and the herbaceous vegetation largely disappears.

The wooded foot-hills, are less common, but they occur at intervals in the Laramie range, much more frequently in the Medicine Bow Mountains and the Wind River range. The arboreal vegetation consists of only a few species, unless one includes the Willows that skirt most of the streams that flow from the higher mountains. Lodge Pole Pine, Douglas Spruce, Rocky Mountain White Pine, Black Cottonwood (*Populus angustifolia*) and more rarely Blue Spruce, Engelmann's Spruce and Rydberg's Cottonwood(*Populus acuminata*) are the most frequently met with. The shrubs are more varied and include, besides those mentioned for the drier hills, *Juniperus*, *Prunus*, Willows and Quaking Asp. The latter in some places becomes a small tree and is in fact found at all altitudes along streams or on hill-sides below snow banks. The smaller vegetation likewise includes a much greater number of species, each of which apparently strives for the mastery and produces the most beautiful confusion of forms.

THE MOUNTAIN FLORA.

Some of the mountain ranges are quite heavily timbered, notably the Medicine Bow and Wind River ranges. The Laramie Mountains are wooded only in part and some of these areas very sparsely. Other ranges are known to be wooded, but I speak only of those I have visited. The summits of the Laramie Mountains are mostly rounded and undulating, and on these we find a scattering growth of Rocky Mountain Yellow Pine (*Pinus ponderosa scopulorum*) and occasionally some straggling, stunted specimens of the Virginia Juniper. Wherever we find the range broken by more abrupt slopes, deeper canons and water courses, the arboreal vegetation assumes the character of a forest, and in some districts furnishes valuable lumber. This is the case at Laramie Peak and on some of the spurs that run out from it. The forests consist mostly of Douglas Spruce, Rocky Mountain White Pine and Lodge Pole Pine.

Much the larger part of the Medicine Bow Mountains are heavily wooded, and it is from these forests that the larger part of the native lumber used in the southern part of the state is obtained. About the same species prevail as in the Laramie Mountains, with the addition of the Blue Spruce and Engelmann's Spruce. The White Pine (*Pinus flexilius*) and Douglas Spruce form much the larger part of the whole. The latter, along the streams at the foot of the ranges, reaches its greatest size and it gradually comes to form a larger proportion of the whole until at 9,000 feet and upward it constitutes practically an unbroken forest to the exclusion of other species. At timber line it becomes scattering, dwarfed and depressed, spreading out like a huge mat under the enormous pressure of the winter snows.

Practically the same conditions prevail in the Wind River Mountains, and probably, though I cannot speak from observation, in the Big Horn Mountains.

Of the fruticose and herbaceous vegetation I need not speak here, although the summits of these ranges yield many beautiful and strictly alpine forms. These all receive comment in their proper place in the list, so space may not be consumed for that purpose here.

THE TREES OF THE STATE.

A list of the trees of the state is indeed very short and were those on the border line between trees and shrubs excluded in would be shorter yet by a third.

Rocky Mountain Yellow Pine (*Pinus ponderosa scopulorum*).
Rocky Mountain White Pine (*Pinus flexilis*).
Lodge Pole Pine (*Pinus Murrayana*).
Engelmann's Spruce (*Picea Engelmanni*).
Blue Spruce (*Picea pungens*).
Douglas Spruce (*Pseudotsuga Douglasii*).
Virginia Juniper (*Juniperus Virginiana*).
Black Cottonwood (*Populus angustifolia*).
Rydberg's Cottonwood (*Populus acuminata*).
Quaking Asp. Aspen (*Populus tremuloides*).
Willow (*Salix longifolia*).
Willow (*Salix flavescens*).
Willow (*Salix amygdaloides*).
Willow (*Salix lasiandra*).
Green Ash (*Fraxinus viridis*).
Box Elder (*Negundo aceroides*).

Scrub Oak (*Quercus undulata*)
Wild Plum (*Prunus Americana*).
Wild Cherry (*Prunus demissa*).
Wild Cherry (*Prunus Virginiana*).
Hawthorn (*Cratægus rivularis*).
Hawthorn (*Cratægus Douglasii*).
Service Berry (*Amelanchier alnifolia*).
(*Eleagnus argentea*).
Buffalo Berry (*Shepherdia argentea*).
Black Birch (*Betula occidentalis*).
Black Alder (*Alnus incana virescens*).
Sage Brush (*Artemisia tridentata*).

In a few localities of the state occasional specimens of Sage Brush attain a remarkable size—small trees in fact—so that a man on horseback may ride erect underneath the branches.

Other species have been reported but until the specimens are at hand they will not be listed. The number of shrubby plants is so great that to list them separately would be to reprint a large part of the succeeding systematic list.

THE FLORAS OF THE PACIFIC AND THE ATLANTIC SLOPES.

I have had no opportunity to compare the floras of the two regions except in so far as the plants on the western side of the Wind River range and those of Jackson's Hole and the Tetons, all of which are on the Pacific slope, may be compared with those on the eastern side of the Wind River Mountains and those of the south-eastern part of the state, which represent the Atlantic slope. Such examination has led to the conclusion that the continental divide, though dividing the waters, does not separate floras. The two regions have a far larger number in common than they have of forms that are distinct. While my collection lists show much that is different, I firmly believe that the difference is due mainly to the season in which each was collected. I am confirmed in this by an examination of the lists given in Dr. J. M. Coulter's report on the Botany of the Hayden U. S. Geological Survey, 1872. These lists comprise those collected, 1. On both slopes; 2. Only on the eastern slope, and 3. Only on the western slope. Those of the last list were collected in the earlier part of the season, and a remarkable number are the same as those of my list for the eastern slope during the same months. Different localities and seasons yield different results, but complete collections would reveal no abrupt transitions; Iowa and Utah, for instance, have different floras, but any fifty or one hundred miles between, even at the summit of the Rockies, will show only the most gradual substitutions. One form disappears, a new one appears, but this occurs with a change of locality in any direction. On the plains of the Platte and its tributaries *Cleome integrifolia* only is found, while on Wind River and its tributaries *Cleome lutea* is the only form.

INTRODUCED PLANTS.

By introduced plants reference is made only to such as grow without cultivation. Most of them may properly be called "Weeds." This is an ever-growing list and will soon include a large part of those familiar to the eastern farmer. The extension of our agricultural interests of course includes the importation of seed, and rarely is any kind of seed free from weed seeds. Some of our weeds, however, are native plants and thrive immensely under cultivation. Those of special interest receive notice in the proper place in the list, and possibly a future bulletin may deal with the weed problem in this state.

HARDINESS OF NATIVE PLANTS.

The power to withstand frost, so remarkably developed in mountain floras, has undoubtedly often been remarked upon before, but it is, nevertheless, unceasingly a cause of wonder. To see great beds of Phlox, Mertensia, Gilia, Actinella and scores of others in full bloom at times when the temperature at night is 5° to 20° F., below the freezing point is a phenomenon that can scarcely be explained. That reduced atmospheric pressure plays an important part in preventing injury, I think must be accepted, for the same plants at lower altitudes would perish. The following observation goes to prove this: Late in August in 1890, a plot of potatoes was noted in full blossom at Mountain Home, elevation about 9,000 feet. Observations on three successive days showed no trace of injury though on both of the intervening nights there were heavy white frosts and films of ice formed on water pails. Such a degree of cold would have absolutely killed potatoes at sea-level.

FLORAL CALENDAR.

In 1894 every effort was made to keep pace with the floral procession. At the altitude of the Laramie Plains, (7,000 feet), Spring opens comparatively late. April furnishes very few objects of interest to the botanist. The earliest flowers are *Phlox cæspitosa* and *Townsendia sericea*, both of which expand their blossoms scarcely above the surface of the ground. These are soon followed by some small *Umbelliferæ*, among which *Cymopterus montanus* may be noted. Toward the end of the month a few more begin to appear on the plains and in the foot-hills, all of which possess either large, fleshy, perennial roots, as *Leucocrinum montanum*, *Musenium trachycarpum* and *Peucedanum nundicaule*, or else they have large woody subterranean stems from which spring the small leaves and numerous flowers that spread out in dense mats or cushions upon the cold soil. Such are *Astragalus spatulatus* and *Astragalus sericoleucus*. Among the rocks in sheltered nooks are also two *Mertensias*, *lanceolata* and *alpina*. With the advent of May, or sometimes earlier, the little *Drabas*, *glacialis* and *alpina* tinge the naked rocks with yellow. In the moister canons our earliest Buttercup, *Ranunculus glaberrimus*, and the Wind-flower, *Anemone patens Nuttalliana*, are found.

Very slowly through May, for cold days and snowstorms are far from rare, the number grows so that the diligent observer may find several score. From this time on the forms crowd upon each other in rapid succession and one soon loses track of the order of their coming. June is the floral month of the plains, July of the lower mountains and August is the month of months in the high altitudes. September has something of worth everywhere and a few forms linger late into October.

BOTANICAL WORK IN THE STATE.

So far as I have been able to learn there are no other workers in systematic botany in the state, nor are there any other herbaria, public or private. On this account I have been unable to make comparison of our specimens with those from other localities in the state.

As before stated the following list is based wholly upon specimens in our herbarium. Plants reported as in the state are not included but appended in separate lists, each under heads showing by whom and from what locality reported.

NOMENCLATURE AND CITATIONS.

As the discussion of the nomenclature question is still waxing warm, happily with less acerbity than before, it has seemed almost a matter of indifference what view of the question was taken with reference to this report. Not that it is a matter of indifference to any worker in the field of botany, but the question seems so far from settlement that one may still expect almost any solution. Stability is the object all have in view and those who publish work of any kind will use that nomenclature which seems to them to offer the greatest chances for permanency. So long as different adherents of the so-called "new nomenclature" are far from agreed among themselves, as witness recent publications, there is small inducement to abandon a fairly satisfactory system. That there is room for improvement none will deny, but until there is international agreement we shall hardly reach a permanent, much less an ideal nomenclature.

I greatly regret that citations in many instances are quite incomplete. Meager library facilities must be my excuse.

Where the recent "List of Pteridophyta and Spermaphyta of the Northeastern United States" recommends a name, different from that used in this report, such name is given as a synonym without citation.

For the citations given I am often indebted to the above list; to recent publications from the Division of Botany, U. S. Dept. of Agriculture; to various publications from the Gray Herbarium and to several other papers and reports.

CRYPTOGAMS.

In 1894 no Cryptogams were collected except a few Ferns. In 1895 efforts were made to secure the Mosses as well. No attention was given to the other groups but incidentally a few Lichens and Fungi were picked up. In future collecting it is purposed to give more attention to this part of the flora.

ACKNOWLEDGEMENTS.

I have pleasure in acknowledging the generous assistance of the various members of the collecting party of 1894. To Prof. W. C. Knight I am indebted for specimens and information in the field and subsequently for literature and data upon various topics. The services rendered by Prof. B. C. Buffum in the field I have previously mentioned; his continued interest and occasional assistance is greatly appreciated. To Mrs. Celia A. Nelson much credit is due for her painstaking care in the preparation of specimans and her devotion to the work during the expeditions of 1895. The task of putting this manuscript in shape for the printer is work for which I am also largely indebted to her.

For assistance in the determination of certain groups I am greatly indebted to the following specialists: To Dr. B. L. Robinson, to whom a considerable number were submitted for comparison and determination. For careful reports upon these I am indebted to him and Mr. M. L. Fernald. Certain orders and genera were submitted only in part as follows: ***Astragalus*** to Prof. E. P. Sheldon; ***Umbelliferæ*** to Dr. J. N. Rose; ***Juncus*** to Dr. F. V. Coville; ***Gramineæ*** to Dr. F. Lamson-Scribner; ***Carex*** to Prof. L. H. Bailey; ***Salix*** to the late Mr. M. S. Bebb; ***Filices*** to Prof. L. M. Underwood; ***Musci*** to Prof. J. M. Holzinger; ***Fungi*** to Mr. J. B. Ellis; ***Lichens*** to Dr. J. W. Eckfelt. Lastly I would mention the kindness of Prof. E. L. Greene, who has furnished determinations, corrections and valuable suggestions on a number of miscellaneous specimens.

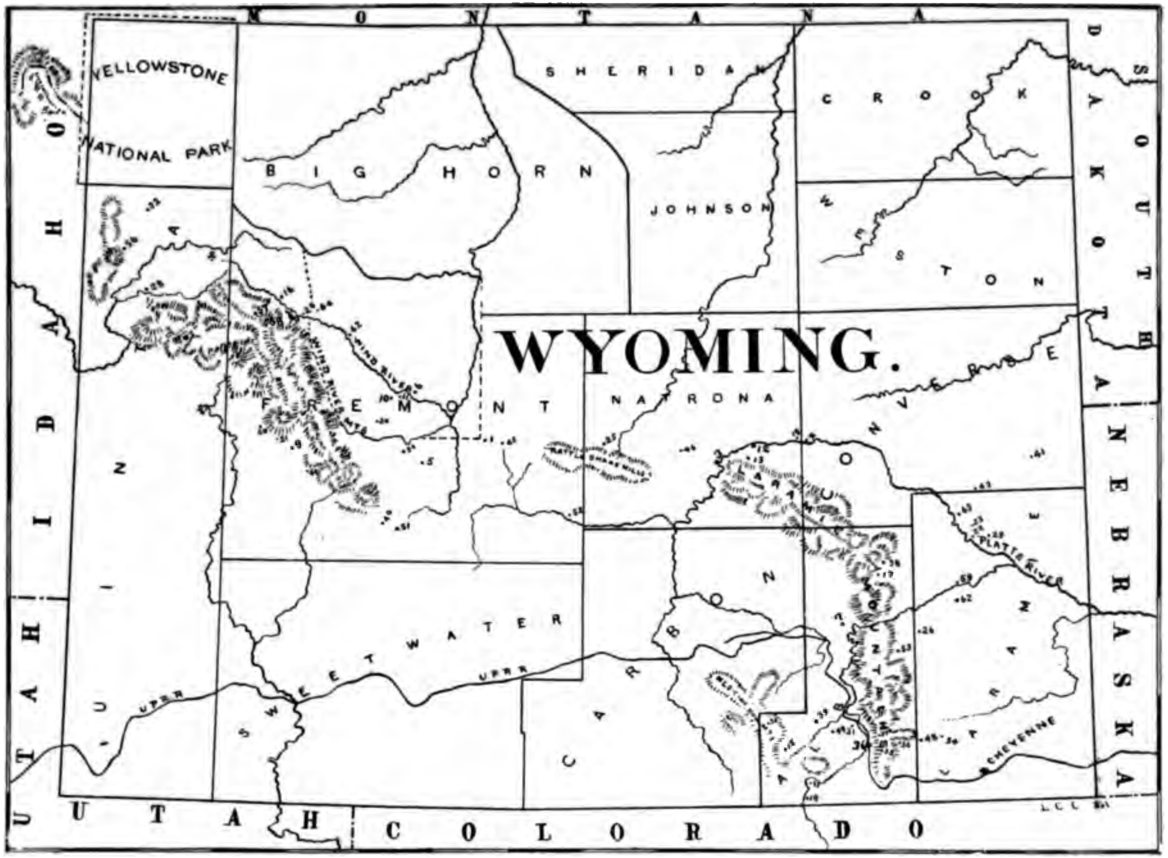
EXPLANATIONS.

All comments upon plants, such as rare, frequent, etc., refer to this state and in partictular to those parts of the state which this report covers. The number in parenthesis following the comments upon each species is the collection number and will render reference to the specimen easy in case any are found incorrectly determined.

PRINCIPAL CAMPS AND COLLECTING LOCALITIES.

The following table contains the principal points in the neighborhood of which most of the material was secured. The altitudes given are only approximate and for hills, mountains, etc., the extremes may be less or greater than given.

NO.	PLACE.	COUNTY.	ELEVATION—FT.
1.	Alkali Springs	Fremont	5500
2.	Bacon Creek	Uinta	7000-8000
3.	Bessemer	Natrona	5300
4.	Big Muddy Creek	Converse	5000
5.	Big Popo Agie River	Fremont	5200
6.	Big Wind River	Fremont	5200
7.	Blue Grass Creek	Albany	6000-7000
8.	Blue Grass Hills	Albany	6500
9.	Boulder Creek	Fremont	7400
10.	Bull Lake	Fremont	5350
11.	Bull Lake Creek	Fremont	5300
12.	Casper	Natrona	5200
13.	Casper Mountain	Natrona	5500-6500
14.	Centennial Hills	Albany	8000-9500
15.	Centennial Valley	Albany	7500-8000
16.	Clark's Ranch	Fremont	7200
17.	Cottonwood Canon	Albany	6000-6500
18.	Cummins, vicinity of	Albany	8000-9000
19.	C. Y. Ranch	Converse	5000
20.	Dubois	Fremont	7000
21.	East Fork	Fremont	7300
22.	Fairbanks	Laramie	4200
23.	Ford J. Ranch	Laramie	4500
24.	Fort Washakie	Fremont	5200
25.	Garfield Peak	Natrona	6000-8000
26.	Grant	Laramie	6000
27.	Green River	Uinta	8000
28.	Gros Ventre River	Uinta	7000
29.	Hartville	Laramie	4500
30.	Horse Creek	Albany	7300-7800
31.	Howell Lakes	Albany	7000
32.	Jackson's Hole	Uinta	6500
33.	Jelm Mountain	Albany	8000-9000
34.	Lander	Fremont	5300
35.	La Plata Mines	Albany	11000
36.	Laramie	Albany	7200
37.	Laramie Hills	Albany	7500-8500
38.	Laramie Peak	Albany	7000-9000
39.	Laramie Plains	Albany	7000
40.	Little Sandy	Fremont	7000
41.	Lusk	Converse	5000
42.	Meadow Creek	Fremont	6500
43.	Mexican Mines	Converse	4750
44.	Muddy Creek	Fremont	7000
45.	Musk-rat Creek	Fremont	5500
46.	Platte River	Laramie	4200
47.	Poison Spider Creek	Natrona	5500-6000
48.	Pole Creek	Albany	7000-8000
49.	Seven-mile Lake	Albany	7000
50.	Silver Creek	Fremont	7000
51.	South Pass City	Fremont	7500
52.	Sweetwater River	Fremont	6000-7000
53.	Sybille Creek	Albany	6000-7000
54.	Table Mountain	Laramie	7000-8000
55.	Telephone Canon	Albany	7500-8000
56.	Teton Mountains	Uinta	7000-11000
57.	Union Pass	Fremont	8000-10000
58.	Union Peak	Fremont	10000-11000
59.	Uva	Laramie	4500
60.	Warm Spring Creek	Fremont	8000
61.	Whalen Canon	Laramie	4750
62.	Wheatland	Laramie	4700
63.	Willow Creek	Laramie	4500
64.	Wind River, North Fork of	Fremont	6500



MAP OF PRINCIPAL COLLECTING POINTS.

The numbers are those of the accompanying Table of Localities.

LIST OF SPECIES.

RANUNCULACEÆ.

Clematis ligusticifolia, Nutt, Torr. & Gray, Fl. i, 9 (1838).

From type locality, viz: "Plains of the Rocky Mountains, in open and in bushy places near streams." Rather frequent.

Blue Grass Creek, Fl. July 8, 1894 (No. 361); Popo Agie River, Fr. August 3, 1894 (No. 712). *Virgin's Bower.*

Clematis Douglasii, Hook. Fl. Bor. Am. i, 1 (1829).

Observed only in one locality, on open hillside.

Laramie Hills, June 9, 1894 (No. 202).

Clematis verticillaris Columbiana, M. E. Jones.

Infrequent, on moist wooded hillsides.

Pole Creek, May 25, 1894 (No. 72).

Thalictrum Fendleri, Engelm. Gray Pl. Fendl. 5.

Common in wet Meadows.

Horse Creek, June 9, 1894 (No. 189); East Fork, August 25, 1894 (No. 1119). *Meadow Rue.*

Thalictrum occidentale, Gray. Proc. Am. Acad. viii, 372.

In thickets along mountain streams, variable as to number of akenes which sometimes are 7-12.

Jackson's Hole, August 20, 1894 (No. 937); Gros Ventre, August 25, 1894 (No. 1067).

Thalictrum purpurascens, L. Sp. Pl. 1753.

Found but once, probably confined to the north and east.

Whalen canon, July 17, 1894 (No. 512);

Thalictrum sparsiflorum, Turcz. in Ind. Sem. Petr. i, 40.

On mountain streams, 8000 ft. and upward.

Cummins, July 30, 1895 (No. 1494).

Anemone cylindrica, Gray, Ann. N. Y. Lyc. iii, 221.

Not common, in fertile valleys, near streams.

Laramie Peak, August 5, 1895 (No. 1583).

Anemone multifida, Poir, Suppl. i, 364.

Infrequent, moist mountain valleys.

Laramie Hills, June 22, 1894 (250), B. C. Buffum; Upper Wind River, August 10, 1894 (No. 756).

Anemone patens Nuttalliana, Gray, Man. Ed. 5, 36 (1867). *Pulsatilla hirsutissima.* (Pursh) Britton.

One of the earliest flowers, on moist, rich canon-sides.

Laramie Hills, Fl. May 4, 1894 (No. 2); Fr. May 29. *Wind Flower.*

Anemone Pennsylvanica, L. Mant. ii, 247. *A. Canadensis,* L.

Very abundant on streams in the eastern part of the state.

Pole Creek, June 2, 1894 (No. 139); Sybille Creek, July 8, 1894 (No. 406).

Ranunculus acriformis, Gray, Proc. Am. Acad. xxi, 374.

Common on creek and river bottoms, at least in Albany county.

Horse Creek, June 9, 1894 (No. 199); Little Laramie River, June 9, 1895 (No. 1306). *Buttercup.*

Ranunculus affinis cardiophyllus, Gray, Proc. Acad. Phila. 56 (1863).

This seems to be a good variety, easily distinguished from var. *validus,* Gray, by the smaller size of the plant, and by the thinner leaves which are either somewhat acute or show a tendency to become divided. Mountain meadows at 7000-8000 ft. Pole Creek, June 2, 1894 (No. 126).

Ranunculus affinis validus, Gray.

Wet meadows, Horse Creek, June 9, 1894 (No. 195).

Ranunculus alismæfolius, Geyer. Benth. Pl. Hartw. 295 (1839).

This is not quite typical and is probably var. *montanus,* Watson, or *R. alismellus,* Greene. Medicine Bow Mountains, at 11,000 ft. August 23, 1895 (No. 1762).

Ranunculus aquatilis trichophyllus, Gray, Man. Ed. 5, 40 (1867). *Batrachium trychophyllum,* (Chaix) Bossch.

Common in slow-moving streams. Muddy Creek, August 25, 1894 (No. 1112).

Ranunculus Cymbalaria, Pursh, Fl. Am. Sept. 392 (1814). *Cyrtorhyncha Cymbalaria,* (Pursh) Britton.

Very common in wet alkali soils. Laramie, at various times, the plant remaining in blossom throughout the season; Lander, August 3, 1894 (No. 693).

Ranunculus Eschscholtzii, Schlecht. Animad. Ranunc. ii, 16.

Union Peak, August 13, 1894 (No. 1003); Medicine Bow Mountains, at 11,000 ft., August 22, 1895 (No. 1780).

Ranunculus eximius, Greene, Erythea iii, 19 (1895).

A most beautiful large-flowered species collected by B.C. Buffum at Bald Mountain, August 15, 1892. The specimens in our herbarium are in part the ones from which the original description was drawn.

Ranunculus flammula reptans, Mey. Pl. Lab. 96 (1836). *R. reptans,* L.

Not common, creeping among the stones on the shore of Bull Lake Creek, August 9, 1894 (No. 729).

Ranunculus glaberrimus, Hook. Fl. Bor. Am. i, 12, t. 5.

Our specimens are the form represented by Prof. Greene's *R. ellipticus,* Pittonia, ii, 110. Our earliest Buttercup; very abundant among the sage brush in moist valleys; Laramie Hills, April and May, 1894 (No. 3).

Ranunculus Macounii, Britton, Trans. N. Y. Acad. Sci. xii, 3 (1892).

Frequent on low-lying wet lands; Big Wind River, August 9, 1894 (No. 723); Cummins, July 29, 1895 (No. 1483).

Ranunculus natans, C. A. Mey. in Ledeb. Fl. Alt. ii, 315.

In the mountains, on the muddy banks or in the water of partially dried up lakes. Union Pass, August 10, 1894 (No. 808); East Fork, August 27, 1894 (No. 1113).

Ranunculus Nuttallii, Gray, Proc. Acad. Phila. 56 (1863). *Cyrtorhyncha ranunculina,* Nutt.

Very abundant on rocky ridges at 8,000-9,000 ft. Laramie Hills, May and June, 1894 and 1895 (Nos. 76 and 1237).

Ranunculus Purshii, Richards. Frank. Journ. 741 (1823).

In the bed of a recently dried up lake, Union Pass, August 14, 1894 (No. 880).

Ranunculus rhomboideus, Goldie. Edinb. Phil. Journ. vi. 329 (1822). *R. ovalis,* Raf.

Rare, observed only in wet meadows on Pole Creek, May 25, 1894 (No. 78).

Ranunculus sceleratus, L. Sp. Pl. 551 (1753).

Abundant in shallow spring pools; Fairbanks, July 14, 1894 (No. 453).

Caltha leptosepala, D. C. Syst. i, 310.

Very abundant in wet grounds at 9,000- 10,000 ft., greedily eaten by elk and locally called "Elk Slip." Union pass, August 13, 1894 (No. 1023).

Trollius laxus, Salisb. Trans. Linn. Soc. viii, 303 (1803).

In the mountains at 9,000 ft. and upward. Union Pass, August 14, 1894 (No. 886); Medicine Bow Mountains, August 22, 1895 (No. 1709).

Aquilegia cærulea, James. Long's Exped. ii, 345.

The queen of Columbines, superbly handsome. In the woods at 8,000-10,000 ft. Laramie Hills, June 22, 1894 (No. 249), B. C. Buffum.

Aquilegia cærulea alpina, n. var.

This, it seemed to me, must be *A. pubescens*, Coville, but Dr. Robinson thinks it is rather a form of *caerulea*. Further examination convinces me that this is right. It is hardly Dr. Gray's var. *albiflora*, for these specimens are all distinctly yellow and in habitat strictly alpine. The variety differs from the species in the smaller size of the plant and larger leaves with upper leaflets entire; in the smaller flowers and very much shorter spurs.

Possibly confined to the Wind River Mountains, where it occupies crevices and ledges of the naked summits above timber line. Observed by Prof. B. C. Buffum, in such locations in 1892 and collected by the writer on Union Peak at 10,500 ft., August 13, 1894 (No. 894).

Aquilegia Laramiensis, n. sp.

Many stemmed from a rather large, semi-fleshy root; 6-9 inches high. The stems and petioles inclined to be decumbent and diffuse. Spurs short, hooked and knobbed. Slightly pubescent on the underside of leaves, on flowers, follicles and pedicels. Sepals greenish white, lanceolate with emarginate apex; lamina, of the light cream-colored petals, obtuse elliptical, longer than the spur.

It differs from *A. saximontana* in its greater pubescence and larger leaflets; from *A. brevistyla* in having longer petioles with dilated bases; from *A. flavescens* in habit and especially in habitat.*

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*I am indebted to Dr. Robinson for making comparison of this with the nearly related species.

Collected at the foot of Laramie Peak, in the Laramie range, in a canon where it occupied the dry crevices in abrupt cliffs.

Delphinium azureum (?) Michx. Fl. Bor. Am. i, 314 (1803). *D. Carolinianum*, Walt.

Not quite typical but probably a form of this species. Saratoga, June 1893, J. D. Parker.

Delphinium bicolor, Nutt. Journ. Acad. Phila. vii, 10.

Our earliest Larkspur, in dry loam soil of ravines and hillsides.

Telephone Canon, May 23, 1894 (No. 48); Table Mountain, June 28, 1895 (No. 1385).

Delphinium Geyeri, Greene.

A good species, immensely abundant on the Laramie Plains. Frequently greedily eaten by hungry cattle with fatal results, caused by bloating, hence the local common name, "Poison Weed." Laramie Hills, July 10, 1894 (No. 400); South Laramie Plains, July 31, 1895 (No. 1552).

Delphinium scopulorum glaucum, Gray. Bot. Gaz. xii, 52. *D. glaucum*, Wats.

In the mountains at 8,000-9,000 ft.; Union Pass, August 10, 1894 (No. 874); Laramie Peak, August 7, 1895 (No. 1599).

Delphinium scopulorum subalpinum, Gray. Bot. Gaz. xii, 52.

A very beautiful alpine form. LaPlata Mines, 11,000 ft., August 22, 1895 (No. 1761).

Aconitum Columbianum, Nutt. T & G. Fl. i, 34.

Two marked forms occur: The typical one, tall, large-leaved and dark blue or purple flowered; the other, repeatedly observed, has light yellow flowers, the plant is smaller, leaves smaller and less pubescent. Less striking differences have sometimes been held to be specific, so it seems proper that this at least bear the varietal name *ochroleucum*. The former is common in thickets on mountain streams. Collected at Snake River, August 21, 1894 (No. 939); Cummins, July 29, 1895 (No. 1521). The latter, less frequent, in similar locations; collected at Cummins and in Centennial Valley and observed at Laramie Peak.

Actea spicata arguta, Torr. Pacif. R. Rep. iv, 63.

White and red berried forms occasionally found growing together. Garfield Peak, July 29, 1894 (Nos. 681 and 692); Cummins July 27, 1895 (No. 1490).

BERBERIDACEÆ.

Berberis Repens, Lindl. Bot. Reg. t. 1176 (1828).

Common among the rocks in hilly regions. Laramie Hills, May 25, 1894 (No. 66); Centennial Hills, August 1895.

NYMPHÆACEÆ.

Nuphar polysepalum, Engelm. Trans. St. Louis Acad. ii, 283 (1865). *Nymphæa polysepala,* (Engelm.) Greene.

Sub-alpine ponds and lakes, not common.

Medicine Bow Mountains, by Col. S. W. Downey; Union Pass, August 14, 1894 (No. 898). *Yellow Pond Lily.*

PAPAVERACEÆ.

Argemone platyceras. Link & Otto, Icon. i, 85. t, 43 (1828). *Argemone albiflora,* Hornem.

Common on the eastern slopes of the Laramie Hills.

Chugwater Station, B. C. Buffum, July 14, 1891; Sybille Hills, July 8, 1894 (No. 314); Table Mountain, July 1, 1895 (No. 1363). *Poppy.*

FUMARIACEÆ.

Corydalis aurea, Willd. Enum 740 (1809). *Capnoides aureum,* (Willd) Kuntze.

This and the following occurs frequently in dry sandy ravines and on the adjoining hillsides.

Centennial Valley, August 19, 1895 (No. 1679).

Corydalis aurea occidentalis, Engelm.

The variety is far more common than the species.

Telephone Canon, June 3, 1894 (No. 118); Laramie, June 5, 1895 (No. 1241).

CRUCIFERÆ.

Nasturtium obtusum, Nutt. T. & G. Fl. N. A. i, 74 (1838). *Roripa obtusa* (Nutt.) Britton.

Usually found growing in spray of minature waterfalls.

East Fork, August 25, 1894 (No. 1116); Pole Creek, July 2, 1895 (No. 1415).

Nasturtium officinale, R. Br. in Ait. Hort. Kew. Ed. 2, iv, 110 (1812). *Roripa Nasturtium.* (L.) Rusby.

Not common, but introduced into some of the springs about Laramie and probably elsewhere in the state.

State Fish Hatchery, September 24, 1894 (No. 1152). *Water Cress.*

Nasturtium palustre, DC Syst. Veg. ii, 191 (1821). *Roripa palustris,* (L.) Bess.

Only rarely seen, wet lowlands.

C. Y. Ranch, on Big Muddy, July 24, 1894 (No. 638).

Nasturtium palustre hispidum, Fisch & Mey. Ind. Sem. Petr. iii, 41. *Roripa hispida* (Desv.) Britton.

This was found twice but only a specimen or two at a time.

Sybille Creek, July 9, 1864 (No. 300.); South Pass, September 2, 1894 (No. 1185).

Nasturtium sinuatum, Nutt. T. & G. Fl. N. A. i, 73 (1838). *Roripa sinuata,* (Nutt.) A. S. Hitchcock.

Apparently quite common, a weed on the campus and on the Experiment farm. (No. 281).

Nasturtium sp.?

A single specimen collected by B. C. Buffum at Bald Mountain, no fruit. Its affinities are not readily made out at this stage but evidently is none of the above.

Barbarea vulgaris, R. Br. in Ait. Hort. Kew, Ed. 2, iv, 109 (1812). *B. Barbarea,* (L.) Mac M.

Union pass, August 10, 1894 (No. 864); Stout plants, thick pods but otherwise normal.

Arabis.

(For this and a few other genera see appendix.)

Thelepodium. (See appendix.)

Cardamine Breweri, Watson, Proc. Am. Acad. x, 339.

Common, at the water's edge in many of our streams. Pole Creek, June 2, 1894 (No. 158); Cummins, July 28, 1895 (No. 1465).

Cardamine cordifolia, Gray, Pl. Fendl. 8.

On stream banks in mountain thickets, quite infrequent. Cummins, July 27, 1895 (No. 1488).

Cardamine Pennsylvanica, Muhl. Sp. Pl. 3: 486 (1800).

Found but once, Lander Creek, August 30, 1894 (No. 1106).

Lesquerella Ludoviciana, Watson, Proc. Am. Acad. xxiii, 252 (1888). *Vesicaria Ludoviciana,* D. C.

Remarkably abundant on the Laramie Plains, in dry sandy soil. June 1, 1894 (No. 190).

Lesquerella montana, Watson, l. c. 251. *Vesicaria montana,* Gray.

Very abundant on the sandy, stony foothills of the Laramie range. Table Mountain June 2, 1894 (No. 88); Pole Creek, June 30, 1895 (No. 1370).

Physaria didymocarpa, Gray, Gen. Ill. i. 162 (1848).

In gravelly clay banks, infrequent, not readily distinguished from Lesquerella until the pods begin to mature. Gros Ventre River, August 16, 1894 (No. 927); Cummins, July 30, 1895 (No. 1555).

Draba. (See appendix.)

Draba alpina, L. Sp. Pl. ii, 642 (1753).

Abundant, on stony gravelly ridges on the plains and in the foothills. Laramie Hills, May 4, 1894 (No. 4); Laramie River Divide, June 9, 1895 (No. 1223).

Draba crassifolia, Graham, Edinb. New Phil. Journ. 182 (1829).

Infrequent, damp, shaded ground; LaPlata Mines, August 21, 1895 (No. 1838).

Draba glacialis, Adams, Mem. Soc. Nat. Mosc. v, 106.

Frequent and of similar habitat as *D. alpina.* Maturing fruit early in May. (Nos. 62 and 1218).

Draba stenoloba, Ledeb. Fl. Ross. i, 154 (1841).

Very rare, collected by B. C. Buffum, in a gulch near Bald Mountain, August 15, 1892.

Sisymbrium canescens, Nutt. Gen. ii, 68.

As variable as it is frequent in occurrence. Table Mountain, June 30, 1895 (No. 1321); Laramie, June 16, 1894 (No. 247).

Sisymbrium incisum, Engelm. Gray Pl. Fendl. 8.

Difficult to separate from some of its varieties. Wheatland, July 9, 1894 (No. 475); South Pass, August 31, 1894 (No. 1184).

Sisymbrium incisum filipes, Gray, Pl. Fendl. 8.

Not at all common; Laramie, August 1893; near Table Mountain, June 30, 1895 (Nos. 1349 and 1425).

Sisymbrium incisum Hartwegianum, Wats, Bot. cal. i, 41.

Observed but once; Sand Creek, August 26, 1894 (No. 1100).

Sisymbrium linifolium, Nutt. T. & G. Fl. i, 91.

Abundant and of frequent occurrence on the plains and in the foothills. Laramie, June 12, 1894 (No. 173); June 1895 (No. 1420).

Smelowskia calycina, C. A. Meyer, Ledeb. Fl. Alt. iii, 165.

Very rare, found but once and then but a plant or two; Laramie Hills, June 1893.

Erisymum asperum Arkansanum, Gray, Man. Ed. 5, 69.

This variety is of very frequent occurrence; in early summer it forms a very conspicuous object on the sandy plains and hillsides in Albany county. Table Mountain, June 2, 1894 (No. 87); Two Bar Ranch on Blue Grass Creek, July 9, 1894 (No. 377).

Erisymum cheiranthoides, L. Sp. Pl. 661 (1753).

Widely distributed but not particularly abundant; Sybille Creek, July 8, 1894 (No. 404); South Pass, September 1, 1894 (No. 1187), and Cummins, July 30, 1895 (No. 1462).

Erisymum parviflorum, Nutt. T. & G. Fl. N. A. i, 95 (838.) *E. inconspicuum.* (Wats.) MacM.

Frequent; Laramie, June 20, 1894 (No. 221); Bacon Creek, August 15, 1894, (No. 916).

Stanleya pinnatifida, Nutt. Gen. ii, 71 (1818). *S. pinnata,* (Pursh) Britton.

Only occasionally, on dry gravelly banks; Little Laramie River, June 6, 1894, by Mr. Houghton; Wood's Landing, July 31, 1895 (No. 1554).

Stanleya pinnatifida integrifolia, Robinson, Syn. Fl. i, 179 (1895).

This form much less common; stems numerous from a large deep-set root; on the dry plains west of Laramie, August 26, 1895 (No. 1845).

Stanleya viridiflora, Nutt. T. & G. Fl. i, 98.

Very rare, not found at all by the writer; collected at Wheatland, June 16, 1892, B. C. Buffum.

Brassica campestris, L. Sp. Pl. 666 (1753).

Occasionally seen in waste places about town; Laramie, September 15, 1893.

Brassica sinapistrum, Boiss. Voy. Espagne, ii, 39 (1839-45).

A single specimen from Centennial Valley, August 25, 1895 (No. 1876).

Capsella Bursa-Pastoris, Medic. Pfl. Gatt. i, 85 (1792). *Bursa Bursa-Pastoris,* (L) Weber.

A weed in lawns and dooryards everywhere; University Campus, June 1891.

Lepidium apetalum, Willd. Spec. iii, 439.

Quite common on the Laramie Plains, in some places becoming a weed.

Blue Grass Hills, July 8, 1894 (No. 323); University Campus, July 22, 1895 (No. 1424).

Lepidium montanum, Nutt. T. & G. Fl. i, 116, 669.

Rare, State Fish Hatchery grounds, Laramie, B. C. Buffum, 1892; Carbon, June 18, 1894 (No. 257), Miss Lily Boyd.

Lepidium Virginicum, L. Sp. Pl. 645 (1753).

Occasionally found introduced into lawns and vacant lots. Laramie, June 15, 1891, B. C. Buffum.

Thlaspi alpestre, L. Sp. Pl. ii, 903.

The typical form of this species is abundant in the Laramie Hills on open hillsides at 7,000-8500 ft. Telephone Canon, May 21, 1891, B. C. Buffum; Pole Creek, May 12, 1894 (No. 28).

Thlaspi alpestre glaucum, n. var.

The perennial basal part of stem rather freely branched, herbaceous stems simple and erect, 6-10 inches high; radical leaves broadly to narrowly elliptical, entire or obscurely repand-denticulate; cauline deltoid-auriculate entire. It also differs from the species in the glaucus hue of the leaves, the laxer inflorescence and well marked notch at the apex of the capsule as well as in its habitat. The species flowers in early spring on open hillsides; the variety was collected in the forest almost at timber line, growing in the thick beds of Spruce needles. La Plata Mines, August 21, 1895 (No. 1777).

CAPPARIDACEÆ.

Cleome integrifolia, T. & G. Fl. i, 142.

An obnoxious weed, sometimes occupying acres of ground to the exclusion of everything else. Everywhere on the Laramie plains, and, in fact, all over the south-eastern part of the state. Laramie, June 24, 1894 (No. 297).

Cleome lutea, Hook. Fl- Bor. Am. i, 70, t. 25.

This seems to replace the preceding on the Wind Rivers and in the north-west generally; in sandy soil. Big Wind River, August 5, 1894 (No. 701).

Polanisia trachysperma, T. & G. Fl. N. A. i, 669 (1840).

Widely distributed in the state but not very abundant; on sandy banks. Laramie Plains July 10, 1894 (No. 333); and B. C. Buffum, at Wheatland.

VIOLACEÆ.

Viola blanda, Willd. Hort. Berol. t, 24 (1806).

Quite rare, on mossy bank in the light spray of a little waterfall.

Centennial Hills, June 9, 1895 (No. 1257).

Viola Canadensis, L. Sp. Pl. 936 (1753).

Abundant in thickets along streams.

Head of Pole Creek, May 25, 1894 (No. 44); Near Table Mountain, July 2, 1895 (No. 1406).

Viola canina adunca, Gray, Proc. Am. Acad. viii, 377,

Occurs less frequently than the following, leaves less crowded on the rootstock.

Pass Creek June 20, 1892, B. C. Buffum; Horse Creek, June 9, 1894 (No. 209).

Viola canina Muhlenbergii, Traut. Act. Hort. Petrop. v, 28.

Widely distributed, rather abundant and variable.

Pole Creek June 2, 1894 (No. 146); Centennial Valley, June 9, 1895 (No. 1284).

Viola Nuttallii, Pursh, Fl. Am. i, 174 (1814).

The earliest and commonest Violet on the plains.

Laramie, May 19, 1894 (No. 37); May 23 1895 (No. 1229).

Viola palmata cucullata, Gray, Bot. Gaz. xi, 254 (1886).

Infrequent. Horse Creek, June 9, 1894 (No. 191).

Viola palustris, L. Sp. Pl. ii, 934 (1753).

A beautiful little plant observed but once, on a boggy bank.

Pole Creek, June 2, 1894 (No. 140).

Viola præmorsa, Dougl. Lindl. Bot. Reg. i, 1254.

This must be very rare in the state and its occurrence here extends its range considerably. Observed both in 1894 and in 1895, only at the head of Pole Creek, May, (Nos. 43 and 1215).

CARYOPHYLLACEÆ.

Saponaria Vaccaria, L. Sp. Pl. 409 (1753).

This is becoming a troublesome weed in some parts of the state. From the Big Horn Mountains, by B. C. Buffum in 1892; Wheatlond, July 11, 1894 (No. 474).

Silene acaulis, L. Sp. Pl. ii, 603 (1762).

Strictly alpine, Teton Mountains, August 21, 1894 (No. 973); Medicine Bow Mountains, August 22, 1895 (No. 1828),

Silene antirrhina, L. Sp. Pl. 419 (1753).

Widely distributed and not rare. Platte River, July 14, 1894 (No. 493); Centennial Valley, August 17, 1895 (No. 1658).

Silene Douglasii multicaulis, Robinson, Contr. Gray, Herb. 144 (1893).

Union Pass at 10,000 ft., August 13, 1894 (No. 1019).

Silene Douglasii viscosa, Robinson, l. c. 145.

This is not quite typical but Dr. Robinson thinks it too near to be separated. Union Pass, August 11, 1894 (No. 845).

Silene Hallii, Watson, Proc. Am. Acad. xxi, 446.

On grassy, open slopes at high elevations; LaPlata Mines, August 21, 1895 (No. 1829).

Agrostemma Githago, L. Sp. Pl. 435 (1753).

As yet very rare in the state. Collected at Sugg's Road by B. C. Buffum August, 1891.

Cerastium alpinum Behringianum, Regel. Ost. Sib. i, 435.

Not common even in the mountains; Union Peak, August 13, 1894 (No. 1013).

Cerastium arvense, L. Sp. Pl. 438 (1753).

Very abundant in early summer in the Laramie Hills. Pole Creek, June 2, 1894 (No. 138); near City Springs, June 21, 1891, B. C. Buffum.

Cerastium arvense latifolium, Fenzl. Ledeb. Fl. Ross. i, 412.

Frequent on rocky hills and ledges in the mountains; Laramie Hills, May 24, 1894 (No. 41).

Cerastium arvense maximum, Hollick and Britton, Bull. Torr. Club, xiv, 45.

Apparently rare; near the creek bank on lower Pole Creek, July 1, 1895 (No. 1380).

Cerastium nutans, Raf. Prec. Dec. 36 (1814). *C. longipedunculatum* Muhl.

Collected only in the north-western part of the state; Bacon Creek, August 16, 1894 (No. 924).

Stellaria borealis, Bigel, Fl. Bost. Ed. 2. 182 (1824). *Alsine borealis,* (Bigel.) Britton.

Infrequent; Centennial Valley, August 18, 1895 (No. 1738).

Stellaria longifolia, Muhl. Willd. Enum. 479. *Alsine longifolia,* (Muhl) Britton.

Abundant in wet places along streams; near Table Mountain, July 2, 1895 (No. 1417).

Stellaria longifolia laeta, T. & G. Bibl. Index. 112.

Rare; observed but once, LaPlata Mines, August 21, 1895 (No. 1774).

Stellaria longipes, Goldie, Edinb. Phil. Journ. vi, 327. *Alsine longipes,* (Goldie) Coville.

The commonest of the Chickweeds in Wyoming. Horse Creek, July 11, 1891, B. C. Buffum; Laramie, June 30, 1894 (No. 286). Lander, August 4, 1894 (No. 713).

Stellaria umbellata, Turcz. Cat. Baic. 5.

Frequent in the Mountains at 9,000 to 11,000 ft.; Union Pass, August 13, 1894 (No. 992); LaPlata Mines, August 21, 1895 (No. 1809).

Arenaria congesta, Nutt. T. & G. Fl. i, 178.

In open and in grassy places on hills and in the mountains everywhere; immensely abundant; Little Bald Mountain, August 15, 1892, B. C. Buffum; Laramie Hills, July 7, 1894 (No. 357).

Arenaria congesta subcongesta, Watson, Bot. Cal. i, 60.

Infrequent; only at high altitudes; on the Grand Teton, at 10,000 ft., August 21, 1894 (No. 1059).

Arenaria Fendleri, Gray, Pl. Fendl. 13.

This, like *A. congesta,* is found everywhere in the hills and mountains, in dry open rather than shaded ground. Laramie Hills, July 7, 1894 (No. 353).

Arenaria Hookeri, Nutt. T. & G. Fl. N. A. i, 178 (1838).

This is of very frequent occurrence both on the plains and in the mountains. Somewhat variable in general appearance; that on the plains short and forming large mats; that in the hills growing in the Pine needles in the shade less, cæspitose and of ranker growth. Laramie, June 20, 1894 (No. 225); Wind River Mountains, August 11, 1894 (No. 856); Laramie Peak, August 7, 1895 (No. 1595).

Arenaria Sajanensis, Willd. Schlecht. Berl. Mag. Natf. 200 (1816).

This plant collected at almost the opposite extremes of the state seems to confine itself to the naked alpine summits. Union Peak, August 13, 1894 (No. 1009); La Plata Mines, August 22, 1895 (No. 1826).

Arenaria sp. (See appendix).

Tissa sparsiflora, Greene, Erythea, iii, (1895).

This recently described species seems to have a very circumscribed range. It was first observed in the autumn of 1894, when it was collected by the writer in a wet meadow, some seven miles from Laramie, in a soil strong with alkali, receiving seepage water from an irrigation ditch. A very rank growth, resulting in long, lax and sparsely flowered stems had been attained. Observations upon it in 1895 in the same and other localities show that, under normal conditions, it grows to only 3-8 inches in height; that it is nearly erect, but freely branched from the base. This shortening of the stems shows the flowers to be numerous in proportion to the size of the plant and makes the specific name hardly characteristic. In the original description the observation is made that it is the first Tissa reported from the interior of the continent. Observed only about Laramie and in low alkali ground. Seven Mile Lake, October 15, 1894 (No. 1158); Laramie, September 3, 1895 (No. 1868).

PORTULACACEÆ.

Portulaca oleracea, L. Sp. Pl. 445 (1753).

Becoming introduced in some localities; from Sheridan Expt. Farm, by the superintendent, J. F. Lewis, September 1895.

Calandrinia pygmæa, Gray, Proc. Am. Acad. viii, 623.

A beautiful little plant of alpine habitat. Union Peak, August 13, 1894 (No. 1015); La Plata Mines, August 20, 1895 (No. 1778).

Claytonia Caroliniana sessilifolia, Torr. Pac. R. Rep. iv, 70 (1856).

Common on hillsides in rich, damp soil. Laramie Hills, May 12, 1894 (No. 27); Pole Creek, May 18, 1895 (No. 1219).

Claytonia sp.?

This may be a reduced alpine form of the preceding. The whole plant is small, 1-2 inches high, raceme reduced to one or two flowers and the leaves more acutely lanceolate. Collected on the shores of a lake at 9,000 ft. on the Grand Teton, August 21, 1894 (No. 1061).

Claytonia Chamissonis, Esch. & Spreng. Syst. i, 790 (1825).

Not of frequent occurrence, but sometimes growing in the greatest profusion on the rocky beds of slow-flowing brooklets; Sybille Creek, July 8, 1894 (No. 309); Pole Creek, June 30, 1895 (No. 1337).

Lewisia rediviva, Pursh, Fl. ii, 368 (1814).

Comparatively rare, but occurring occasionally in profusion among the sage brush on the plains, and sometimes in the pine needles of rather open woods in the foothills. Sweetwater River, June 22, 1891, D. McLaren; Garfield Peak, July 29, 1894 (No. 679); Cummins, July 27, 1895 (No. 1545).

HYPERICACEÆ.

Hypericum Scouleri, Hook. Fl. Bor. Am. i, 111 (1830). *H. formosum Scouleri,* (Hook.) Coult.

Quite rare; in thickets along streams. Sybille Creek, July 8, 1894 (No. 341).

MALVACEÆ.

Sidalcea candida, Gray, Pl. Fendl. 20 and 24.

Frequent and abundant in thickets along streams in the mountains at 8,000-9,000 ft. Centennial Valley, September 8, 1891, B. C. Buffum; Cummins, July 31, 1895 (No. 1489).

Sidalcea malvæflora, Gray, Pl. Wright. i, 16 (1852).

Habitat and localities similar to those of the preceding; possibly of more frequent occurrence, the two species sometimes growing together. Saratoga, July 2, 1893, J. D. Parker; Cummins, July 28, 1895 (No. 1463).

Malvastrum coccineum, Gray, Mem. Am. Acad. iv, 21 (1848).

A common weed on the plains, in fields and fence corners. University Campus, June 22, 1894 (No. 280).

Sphæralcea acerifolia, Nutt. T. & G. Fl. N. A. i, 228 (1838).

Not abundant but widely distributed; in open woods at 8,000-9,000 ft. Union Pass, August 10, 1894 (No. 873); Centennial Valley, August 17, 1895 (No. 1727).

Sphæralcea Munroana, Spach. Proc. Am. Acad. xxii, 292 (1887).

Laramie, September 1, 1893; Sheridan Experiment Farm, September 1895.

LINACEÆ.

Linum Kingii, Watson, King Rep. v, 49 (1871).

A few specimens of this species were secured by Prof Buffum in 1892, but without data; probably collected late in June, near Elk Mountain.

Linum perenne, L. Sp. Pl. 277 (1753). *L. Lewisii,* Pursh.

Remarkably abundant and luxuriant throughout the state. Found on dry, rocky ridges as well as on rich hillsides and valleys. The valley of Bacon Creek in August presents the appearance of a flax field. Laramie, June 12, 1894 (No. 241); Union Pass and Bacon Creek, August 1894 (No. 866).

Linum rigidum, Pursh, Fl. Am. Sept. 210 (1814).

Common in the eastern part of the state. Inyan Kara Divide, August 29, 1892, B. C. Buffum; Wheatland, July 9, 1894 (No. 384).

GERANIACEÆ.

Geranium cæspitosum, James, Long's Exped. ii, 3.

Very frequent in the Laramie Hills, growing in scattered clumps on rocky ridges. By B. C. Buffum in 1892; Telephone Canon, June 15, 1894 (No. 233).

Geranium Fremonti, Torr. Gray, Pl. Fendl. 26.

Rare, observed but once; Union Pass, August 11, 1894 (No. 824).

Geranium Richardsoni, Fisch. Mey. Ind. Sem. Petr. iv, 37.

Frequent in the south-eastern part of the state at least; along streams and in damp thickets. Pole Creek, June 2, 1894 (No. 132); near Table Mountain, July 1, 1895 (No. 1403).

Oxalis stricta, L. Sp. Pl. 281 (1753).

This is the only species so far found in the state and this but once. Whalen Canon, July 18, 1894 (No. 522).

CELASTRACEÆ.

Pachystima Myrsinites, Raf. Am. Month. Mag. 176 (1819).

Occurring on the sides of wooded mountains. Tetons, August 22, 1894 (No. 977), at 7,500 ft.

RHAMNACEÆ.

Ceanothus Fendleri, Gray Pl. Fendl. 29 (1849).

Very rare, a single clump of it in an open valley, Laramie Peak, August 8, 1895 (No. 1637.)

Ceanothus velutinus, Dougl. Hook. Fl. Bor. Am. i, 125 (1830).

Presumably throughout the state; dry canon-sides; Beaver Creek by B. C. Buffum, July 17, 1892; Tetons, August 21, 1894 (No. 948); Cummins, July 31, 1895 (No. 1542).

VITACEÆ.

Vitis riparia, Michx. Fl. ii, 231. *Wild Grape.*

This was collected in fruit not yet ripe, in one locality only; on the banks of the Platte River, Fairbanks, July 14, 1894 (No. 468).

Ampelopsis quinquefolia, Michx. Fl. Bor. Am. i, 160 (1803) *Parthenocissus quinquefolia,* (L.) Planch.

Quite rare in the state, possibly not found in the more elevated districts at all. Hartville, July 16, 1894 (No. 554).

SAPINDACEÆ.

Acer glabrum, Torr. Ann. Lyc. N. Y. ii, 172 (1826).

A common shrub on rocky hillsides and in the canons. Telephone Canon, May 23, 1894 (No. 57); Laramie Hills May 25, 1895 (No. 1236). *Maple.*

Negundo aceroides, Moench. Meth. 334 (1794). *Acer Negundo,* L.

Occurring occasionally along streams. Introduced at Laramie for shade and decorative purposes. June 1, 1894 (No. 183); Big Muddy Creek, July 26, 1894 (No. 611). *Box Elder.*

ANACARDIACEÆ.

Rhus toxicodendron, L. Sp. Pl. (1753). *Rhus radicans,* L.

Ours is the low erect form. Among rocks in canons at 5,000-6,000 ft. Table Mountain, June 2, 1894 (No. 154); Hartville, July

16, 1894 (No. 557); noted also at Laramie Peak, growing in profusion in a rocky canon. *Poison Ivy.*

Rhus trilobata, Nutt. T. & G. Fl. i, 219 (1838).

A low, spreading shrub, frequently almost covering both sides and summits of the low rounded hills in the Laramie range. Table Mountain, June 2, 1894 (No. 159); Blue Grass Hills, July 8, 1894 (No. 322); Laramie Peak, August 7, 1895 (No. 1477).

LEGUMINOSÆ.

Thermopsis montana, Nutt. T. & G. Fl. i, 388 (1838).

Not common, occurring on sandy creek banks. Laramie River, fl. June 15, fr. August 19, 1891, B. C. Buffum.

Thermopsis rhombifolia, Richards. App. Frank. Journ. 13 (1823).

Abundant in sandy ravines and valleys in the hills, the great patches of yellow standing out in sharp contrast to the green grass and white rocks. Table Mountain, June 2, 1894 (No. 122); Laramie Hills, June 5, 1895 (No. 1240).

Lupinus argenteus, Pursh, Fl. 468 (1814).

A widely distributed and common species of this well represented and beautiful genus. Apparently at higher altitudes than the var. following. Chugwater Creek, July 7, 1894 (No. 301); Meadow Creek, August 9, 1894 (No. 972); Laramie Peak, August 7, 1895 (No. 1584).

Lupinus argenteus decumbens, Wats. Proc. Am. Acad. xviii, 532 (1873).

On creek banks in the hills and plains. Pole Creek, June 2, 1894 (No. 104).

Lupinus aridus, Dougl. Lindl. Bot. Reg. xv, 1242 (1829).

On the plains of the Sweetwater River, by Geo. M. Cordiner, September 6, 1894 (No. 1206).

Lupinus cæspitosus, Nutt. T. & G. Fl. i, 379.

A delicate little plant almost alpine in its habitat; observed but once; Union Peak, August 13, 1894 (No. 996).

Lupinus laxiflorus, Dougl. Lindl. Bot. Reg. xiv, 1140 (1828).

Frequent and sometimes covering great stretches of the sandy plain with its characteristic color. Blue Grass Creek, July 8, 1894 (No. 360); Lusk, July 21, 1894 (No. 584); also west slope of Wind River Mountains, August 14, 1894.

Lupinus leucophyllus, Dougl. Lindl. Bot. Reg. xiii, 1124 (1828).
Our earliest Lupine, found in great profusion on moist hillsides among the sage brush and even in shaded localities. Laramie Hills, June 2, 1894 (No.151).

Lupinus ornatus, Dougl. Lindl. Bot. Reg. xv, 1216 (1829).
Certainly deserving its name; abundant in the locality noted; Gros Ventre River, August 16, 1894 (No. 1098).

Lupinus parviflorus, Nutt. Hook. & Arn. Bot. Beechy, 336.
Common along streams; Sybille Creek, August 8, 1894 (No. 315); Table Mountain, July 1, 1895 (No. 1414).

Lupinus Plattensis, Wats. Proc. Am. Acad. xvii, 124 (1890).
This rare and beautiful plant was observed in two localities only. Mexican Mines, July 20, 1894 (No. 589); Pole Creek, near Table Mountain, July 1, 1895 (No. 1401).

Lupinus pusillus, Pursh, Fl. Am. Sept. 468 (1814).
Found only on the sand ridges and dunes occurring occasionally on the plains of eastern Wyoming. Platte River, July 14, 1894 (No. 490); noted also south of Lusk.

Lupinus Sitgreavesii, Wats. Proc. Am. Acad. xiii, 527.
Occurs only at comparatively high altitudes in wooded mountains. Union Pass, August 12, 1894 (No. 896); frequent at 9,000 ft. and upward.

Medicago sativa, L. Sp. Pl. 778 (1753). *Lucerne, Alfalfa;* largely grown as a forage plant in the west; escaped from cultivation. Laramie, September 9, 1894 (No. 1136).

Melilotus alba, Lam. Encycl. iv, 63 (1797). *Sweet Clover.*
Persisting in fallow or abandoned fields. Laramie, October 2, 1894 (No. 1154.)

Melilotus officinalis, (L.) Lam. Fl. France, ii, 594 (1778).
Introduced and then persisting in abandoned areas for a number of years, possibly indefinitely. Laramie, June 23, 1895 (No. 1422).

Psoralea argophylla, Pursh, Fl. Am. Sept. 475 (1814).
Noted a number of times in eastern Wyoming; Platte River, July 14, 1894 (No. 497); from Inyan Kara Divide by B. C. Buffum, 1892, and from Sheridan by J. F. Lewis, 1895.

Psoralea lanceolata, Pursh, l. c.

Frequent on the dry foothills along the Platte River. Fairbanks, July 12, 1894 (No. 430); Orin Junction, August 14, 1892, B. C. Buffum.

Psoralea tenuiflora, Pursh, l. c.

Our commonest Psoralea, very abundant along the Platte and its tributaries. Laramie River, July 10, 1894 (No. 368); Blue Grass Creek, July 8, 1894 (No. 306).

Trifolium dasyphyllum, T. & G. Fl. N. A. i, 315.

This fine cæspitose species almost clothes some of the otherwise naked rocky ledges in the Laramie foothills. Some specimens secured at Laramie Peak are quite erect with longer and less pubescent leaves. Laramie, May 25, 1894 (No. 68); June 5, 1895 (No. 1243).

Trifolium gymnocarpon, Nutt. T. & G. Fl. i, 320.

A rare and inconspicuous little plant, blossoming in late spring and shortly disappearing. Laramie, June 9, 1894 (No. 216); Experiment Farm, May 23, 1895 (No. 1230).

Trifolium longipes, Nutt. T. & G. Fl. i, 314 and 691.

Frequent in the mountains at 8,000-9,000 ft. Specimens from Saratoga and Bald Mountain; also Union Pass, August 13; 1895 (No. 1025).

Trifolium longipes reflexum, n. var.

This has the general habit of *T. longipes* but the flowers are at length quite reflexed; calyx lobes shorter and less villous. On the banks of Wind River at the foot of Union Pass, August 9, 1894 (No. 918).

Trifolium Parryi, Gray, Am. Journ. Sci. ii, 33.

Rare, in open spruce woods, Medicine Bow Mountains, August 21, 1895 (No. 1764).

Trifolium pratense, L. Sp. Pl. 768 (1753). *Red Clover.*

Trifolium repens, L. Sp. Pl. 767 (1753).

This and the preceding becoming naturalized along irrigation ditches, in the streets and elsewhere. Laramie, September 15, 1894. *White Clover.*

Amorpha fruiticosa, L. Sp. Pl. 713 (1753).

Frequent on the banks of the Platte in the eastern part of the state. Fairbanks, July 13, 1894 (No. 438).

Dalea aurea, Nutt. Fras. Cat. (1813). *Parosela aurea,* (Nutt.) Britton.

Very rare; on the plains of the Platte; Fairbanks, July 11, 1894 (No. 390).

Petalostemon candidus, Michx. Fl. Bor. Am. ii, 49 (1803). *Kuhnistera candida,* (Willd.) Kuntze.

Occasional, on the dry hills and plains bordering on the Platte. Orin Junction, August 14, 1891, B. C. Buffum.

Petalostemon multiflorus, Nutt. Journ. Phil. Acad. vii, 92 (1834).

This seems to be a much-named plant and illustrates nicely the stability that our nomenclature is acquiring. The new Check List gives *Kuhnistera multiflora,* (Nutt.) Heller, and, if I understand Mr. Rydberg rightly, his new name, *Kuhnistera, candida multiflora,* (Nutt.), Contrib. Nat'l Herb. iii, 3. (1895), is also the same. From the specimens at hand I am inclined to think that Mr. Rydberg is right in reducing the form to a variety. On the other hand his variety *occidentalis* does not seem to differ in any important respect from his *multiflora,* judging by his descriptions. Some specimens at hand will fall nicely under either.

Very frequent in the Laramie Hills and the foothills bordering on the Platte. July 9, 1894 (No. 330); Inyan Kara Divide by B. C. Buffum.

Petalostemon violaceus, Michx. Fl. Bor. Am. ii, 50 (1803). *Kuhnistera purpurea,* (Vent.) MacM.

Habitat and localities much the same as for the preceding. Orin Junction, July 14, 1891, B. C. Buffum; Platte Hills, July 9, 1894 (No. 331).

Astragalus adsurgens, Pall. Astrag. 40, t, 31 (1800). *A. Laxmanni,* Jacq.

Remarkably abundant in the south-eastern part of the state, occupying dry, stony or gravelly ridges on the plains or in the foothills.

Wallace Creek, July 29, 1894 (No. 646); Cummins, July 30, 1895 (No. 1514); at Laramie at various times.

Astragalus alpinus, L. Sp. Pl. 760 (1753).

Probably frequent in the higher mountain valleys; Pole Creek, June 3, 1894 (No. 174); Union Pass, August 11, 1894 (No. 840). Unusually large specimens with leaves varying from elliptical to obcordate were obtained on Union Peak, August 13, 1894 (No. 993).

Astragalus bisulcatus, Gray, Pac. R. Rep. xii, 42 (1860.)

A very common species on the plains and in the foothills; Laramie, June 19, 1894 (No. 266); Garfield Peak, July 29, 1895 (No. 682); other numbers are 1316 and 1435.

Astragalus Canadensis, L. Sp. Pl. 757 (1753). *A. Carolinianus,* L.

Possibly confined to the eastern part of the state.

Lusk, July 21, 1894 (No. 582); Laramie Peak, August 7, 1895 (No. 1597).

Astragalus caryocarpus, Ker. Bot. Reg. t, 176 (1816). *A. crassicarpus,* Nutt.

Infrequent; on the Laramie plains and on the east slopes of the Laramie range. Pole Creek, June 2, 1894 (No. 162); Laramie, June 25, 1894 (No. 201).

Astragalus convalarius, Greene.

I am unable to cite the publication of this; the name was communicated by Prof. Sheldon; probably rare; Union Pass, August 10, 1894 (Nos. 743 and 869).

Astragalus Drummondii, Dougl. Hook. Fl. Bor. Am. i, 153 (1833).

Frequent in the foothills throughout the state; Pole Creek, June 2, 1894 (No. 86); Upper Wind River, August 10, 1894 (No. 763).

Astragalus flexuosus, Dougl., in Don. Gen. Syst. Gard. and Bot. ii, 256 (1832).

On wet, fertile creek banks; Chugwater, July 7, 1894 (No. 422); Pole Creek, July 1, 1895 (No. 1352).

Astragalus frigidus Americanus, Watson, Index, i, 193.

Very rare; South Fork, Crazy Woman Creek, August 7, 1892, B. C. Buffum.

Astragalus giganteus, Sheld. Bull. Minn. Geol. and Nat. Hist. Surv. ix. 65 (894).

Infrequent; Bald Mountain, August 15, 1892; Green River, August 26, 1894 (No. 1047).

Astragalus hypoglottis, L. Mant. ii, 274 (1771).

Frequent and abundant in wet meadows and along streams in our whole range. Saratoga, July 6, 1891; Meadow Creek, August 9, 1894 (No. 815). Fine specimens with ohroleucus flowers were obtained at Meadow Creek, August 9, 1894 (No. 775).

Astragalus Kentrophyta, Gray, Proc. Acad. Philad. 60 (1863).

Probably belonging to the Pacific slopes alone; on the banks of the Gros Ventre River, August 16, 1894 (No. 1077).

Astragalus junceus, Gray, Proc. Am. Acad. vi, 230.

Infrequent; on steep, dry stony hillsides; Saratoga, June 23, 1893; Gros Ventre River, August 17, 1894 (No. 1086).

Astragalus lonchocarpus, Torr. Pac. R. Pep. iv, 80.

What appears to be of this species was collected on Snake River, May 29, 1892, by Fred McCoullough.

Astragalus Missouriensis, Nutt. Gen. ii, 99 (1818).

Abundant on the Laramie plains but in the foothills giving place to *A. Shortianus.* Laramie, May 22, 1894 (No. 52); also in 1895 (No. 1227).

Astragalus Mortoni, Nutt. Journ. Acad. Phila. vii, 19 (1834).

On the Pacific slope only, infrequent; Gros Ventre River, August 16, 1894 (No. 1080).

Astragalus oroboides Americanus, Gray, Proc. Am. Acad. vi, 205 (1864). *A. oroboides,* Hornem.

Infrequent; Bacon Creek, August 15, 1894 (No. 917).

Astragalus pectinatus, Dougl. in Don. Gen. Syst. Gard. and Bot. ii, 257 (1832).

Frequent and abundant on the Laramie Plains; June 12, 1894 (No. 217).

Some forms of it seem to approach *A. Grayi* so closely as to make it difficult to know where to place them, such as my number 1304 from Centennial Valley, June 9, 1895.

Astragalus Purshii, Dougl. Hook. Fl. Bor. Am. i, 152 (1834).

Of frequent occurrence, but the plants few and scattering.

On the Laramie Plains, May 23, 1894 (No. 53); May, 1895 (No. 1228).

Astragalus sericoleucus, Gray, Am. Jour. Sci. II, xxxiii, 410 (1862).

Frequent on the plains and in the foothills, where it clothes the otherwise naked ground as with a purple carpet.

Laramie, May 18, 1894 (No. 38).

Astragalus Shortianus, Nutt. T. & G. Fl. N. A i, 331 (1838).

On gravelly, stony hillsides; frequent in the Laramie range.

Telephone Canon, May 23, 1894 (No. 54); Centennial Valley, June 9, 1895 (No. 1286).

Astragalus spatulatus, Sheld. Bull. Minn. Geol. & Nat. Hist. Surv. ix, 19 (1894).

Very abundant both on the plains and in the foothills.

Laramie Hills, May 16, 1894 (No. 31); Centennial Valley, June 9, 1895 (No, 1301); also a white flowered variety from the latter place.

Astragalus tenellus, Pursh, Fl. Am. Sept. 473 (1814).

Seemingly throughout the state, in dry, sandy soil.

Laramie, June 19, 1894 (No. 267); Dubois, August 9, 1894 (No. 751); Cummins, July 26, 1895 (No. 1432).

Astragalus. (For other numbers see appendix).

Oxytropis deflexa, D C. Prodr. ii ,280.

Infrequent, in mountain Meadows, at 7,000-8,000 ft.; Union Pass, August 11, 1894 (No. 825); Laramie Peak, August 8, 1895 (No. 1530).

Oxytropis Lamberti, Pursh, Fl. Am. Sept. 740 (1814). *Spiesia Lamberti*, (Pursh) Kuntze.

The typical form is not frequent. As far as my observation goes, it is confined to the eastern part of the state. By the typical form is meant the purple-flowered form described in our manuals under this name. Table Mountain, July 1, 1895 (No. 1320).

Oxytropis Lamberti sericea, Nutt. T. & G. i, 339 (1838). *Spiesia Lamberti sericea*, (Nutt.) Rydberg.

Very rare; Laramie, 1893. Flowers violet.

Oxytropis (Spiesia) Lamberti ochroleuca, n. var.

Stout, grayish, with a close pubescence throughout; very many short stems from the large perennial root, each of which bears one to several long scape-like peduncles; flowers yellowish-white with sometimes a purple spot on the keel petals.

This is the frequently mentioned ochroleucus flowered form of this species, but it certainly, with us at least, forms a good and constant variety, if not species. It can always be distinguished by its stouter habit throughout, by the densely lanate scale-like stipules, by the shorter but thicker spike as well as by the very numerous and crowded stems and scapes. Exceedingly abundant; Pole Creek, June 2, 1894 (No. 119); Laramie, June 9, 1895 (No. 1302). *Loco.*

Oxytropis monticola, Gray, Proc. Am. Acad. xx, 6.

Frequent in the vicinity of Laramie; May 23, 1894 (No. 60); June 9, 1895 (No. 1294).

Oxytropis multiceps, Nutt. T. & G. Fl. i, 341 (1838). *Spieşia multiceps,* (Nutt.) Kuntze.

Very rare; on a hilltop of disintegrated granite, near Horse Creek, June 9, 1894 (No. 214).

Oxytropis splendens, Dougl. Hook. Fl. Bor. Am. i, 147 (1833). *Spiesia splendens,* (Dougl.) Kuntze.

This truly splendid species is not rare in the grassy valleys at about 7,000-8,000 ft. and sometimes at lower altitudes. Table Mountain, July 2, 1895 (No. 1391); Cummins July 29, 1895.

Oxytropis sp. ? (Nos 669 and 928, see appendix).

Glyceria lepidota, Pursh, Fl. Am. Sept. 480 (1814).

Frequent near the Platte on the banks of small ditches and ravines. Willow Creek, July 22, 1894 (No. 627); Cheyenne, August 29, 1893.

Hedysarum boreale, Nutt. Gen. ii, 110 (1818). *H. Americanum,* (Michx.) Britton.

Probably infrequent except northward; Union Pass, August 10, 1894 (No. 877).

Hedysarum Mackenzii, Richards, App. Frank. Journ. 17 (1823). *H. Americanum Mackenzii,* (Richards.) Britton.

Throughout the state; Crazy Woman Creek, August 7, 1892; Dubois, August 9, 1894 (No. 752); Snake River, August 19, 1894 (No. 1087).

Vicia Americana, Muhl. Willd. Sp. Pl. ii, 1096 (1803).

Of frequent occurrence in thickets on stream banks. Cummins, July 29, 1895, two forms of it, (Nos. 1450 and 1478).

Vicia Americana truncata, Brewer, Bot. Cal. i, 158 (1876).

More frequent than the species; Wheatland, August 1892, B. C. Buffum; Table Mountain, June 30, 1895 (No. 1404).

Vicia linearis, (Nutt.) Greene, Fl. Fran. 3 (1891).

Especially abundant; on sandy plains and creek valleys everywhere.

Pole Creek, June 2, 1894 (No. 92); Laramie, June 1, 1894 (No. 172); Meadow Creek, August 9, 1894 (No. 776).

Vicia cracca, L. Sp. Pl. 735 (1753).

A chance introduction on the Laramie Experiment Farm, September 1895.

Lathyrus ornatus, Nutt. T. & G. Fl. N. A. i, 277 (1838).

Members of this genus are either very rare or the right localities have not yet been visited. A specimen in the herbarium from Cheyenne, by Miss Helen Furniss, June 1892.

ROSACEÆ.

Prunus Americana, Marsh, Arb. Am. 111 (1785).

Rare in the southeastern part of the state and probably infrequent everywhere except in the lower altitudes of the northeastern part, where it is reported very plentiful.

Fairbanks, July 18, 1894 (No. 572). *Wild Plum.*

Prunus demissa, Walp. Rep. ii, 10 (1843).

This and the succeeding species have so much in common that it is difficult to separate them. It may be that none of the specimens are *P. Virginiana*, but rather only forms of *P. demissa.* Common on dry creek banks in the hills.

Telephone Canon, June 15, 1894 (No. 230); Table Mountain, June 30, 1895 (No. 1402). *Wild Cherry, Choke Cherry.*

Prunus Virginiana, L. Sp. Pl. 473 (1753).

Teton Mountains, August 21, 1894 (No. 943), and by B. C. Buffum, 1892.

Spirea arbuscula, Greene, Erythea, iii, 63 (1895).

Infrequent and, I think, found only at high elevations, 8,000 ft. and upward.

Teton Mountains, August 21, 1894 (No. 941).

Spirea discolor dumosa, Watson, Pursh Fl. 342 (1814).

A handsome shrub, common on rocky ledges at 8,000 ft. and upward.

Casper Mountain, July 26, 1894 (No. 607); Garfield Peak, July 29, 1894 (No. 657); also observed at Laramie Peak and in the Medicine Bow Mountains in 1895.

Spirea lucida, Dougl.

Very rare in the state.

Teton Mountains, August 21, 1894 (No. 949).

UNIV. OF CALIFORNIA

Physocarpus Torreyi, Maxim. *Neillia Torreyi*, Watson, Proc. Am. Acad. xi, 136.

Common in the hills and mountains.

Table Mountain, June 2, 1894 (No. 116); Platte River, July 14, 1894 (No. 490).

Rubus Nutkanus, Mocino, Lindl. Bot. Reg. t. 1368 (1830).

Not common in the parts of the state collected.

Teton Mountains, August 21, 1894, and Centennial Hills, August 18, 1895 (No. 1676). *Thimble-berry.*

Rubus strigosus,. Michx. Fl. i, 297 (1803).

The *Red Raspberry*, growing in the greatest profusion on rocky and partially wooded hillsides, especially on ground once burned over. Immensely productive.

Union Peak, August 13, 1894 (No. 997). Cummins, July 31 1895 (No. 1476).

Purshia tridentata,, D C. Trans. Linn. Soc. 12, 157.

A scragly prostrate shrub, common on low hilltops and hillsides.

Pole Creek, June 2, 1894 (No. 82); Wallace Creek, July 29, 1894 (No. 676); Centennial Valley, June 9, 1895 (No. 1270),

Cercocarpus parvifolius, H. & A. Bot. Beechey, 337 (1841).

This may be called the most characteristic shrub of stony foothills.

Laramie Hills, June 15, 1894 (No. 237); Platte Hills, July 14, 1894 (No. 462). *Mountain Mahogany.*

Geum macrophyllum, Willd. Enum. i, 557 (1809).

Mr. Rydberg* suggests the probability that this and the following are varieties of the same species. The specimens before me, however, seem perfectly distinct. Near streams.

Bacon Creek, August 15, 1894 (No. 920); Cummins, July 30, 1895 (No. 1576).

Geum strictum, Ait. Hort. Kew. ii, 217 (1789).

Same habitat as the preceding.

Sybille Creek, July 8, 1894 (No. 407); Cummins, July 30, 1895 (No. 1517).

Geum triflorum, Pursh, Fl. 736 (1814).

This fine species is common in wet valleys at 7,000-9,000 ft. Our manuals fail to note that the style is jointed in the middle in young specimens, but as the apical portion is early deciduous it appears perfectly straight in maturer blossoms.

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*Contrib. Natl. Herb. iii, 3, 157 (1895).

Union Pass, August 11, 1894 (No. 829); Saw Mill Creek, May 25, 1895 (No. 1258).

Fragaria vesca Americana, Porter, Bull. Torr. Bot. Club, xvii, 15 (1890).

In mountain meadows and valleys, in parks and on wet hillsides everywhere. Sometimes fruiting abundantly, the berries small but sweet.

Horse Creek, June 9, 1894 (No. 207). *Strawberry.*

Fragaria Virginiana Illinœnsis, Prince, Gray Man Ed. 5, 155 (1867).

This species is rare, at least about Laramie, but specimens collected by A. H. Danielson near Jelm Mountain, May, 1895, seem to be of this form (No. 1209).

Potentilla anserina, L. Sp. Pl. 495 (1753).

Common in wet soils, especially near slightly alkali marshes. Laramie all summer.

Collected on Green River, August 26, 1894 (No. 1039).

Potentilla arguta, Pursh, Fl. Am. Sept. 736 (1814).

Forming immense yellow patches among the rocks in the hills. A fine plant.

Pole Creek Hills, June 2, 1894 (No. 95); June 30, 1895 (No. 1351).

Potentilla dissecta, Pursh, Fl. Am. Sept. (1814).

This fine species is probably confined to high elevations.

Teton Mountains, August 22, 1894 (No. 970); LaPlata Mines, August 20, 1895 (No. 1773).

Potentilla fruticosa, L. Sp. Pl. 495 (1753).

Common on the banks of mountain streams.

Wind River, August 9, 1894 (No. 748); Little Sandy, August 30, 1894 (No. 1127).

Potentilla glandulosa, Lindl. Bot. Reg. xix, t. 1583 (1833).

Occasional along streams in sandy loam.

Union Pass, August 12, 1894 (No. 867); Cummins, July 30, 1895 (No. 1493).

Potentilla gracilis, Dougl. Hook. Bot. Mag. (1830).

This is a most polymorphous species, the forms of it differing strikingly as to tomentum, hirsuteness, leaf margin, etc. It seems probable that a careful examination will show at least some varieties which ought to be separated from the species. In wet meadows and along mountain streams.

Laramie River, July 9, 1894 (No. 325); Wallace Creek, July 29, 1894 (No. 665); Wind River Mountains, August 13, 1894 (No. 931); Table Mountain, June 30, 1895 (No. 1347); La Plata Mines, August 21, 1895 (No. 1821).

Potentilla gracilis fastigiata, Watson, Proc. Am. Acad. viii, 557 (1873).

Union Pass, August 13, 1894 (No. 990); Centennial Valley, August 25, 1895 (No. 1858).

Potentilla gracilis flabelliformis, Torr. & Gray, Fl. (1838).

A rare and beautiful plant, the deeply pinnatifid leaflets densely white tomentose on the lower surface.

Meadow Creek, August 9, 1894 (No. 786).

Potentilla Hippiana, Lehm. Nov. Stirp. Pug. ii, 197 (1830).

Very common on rocky slopes and hills.

Laramie Hills, July 7, 1894 (No. 410); Garfield Peak, July 29, (No. 651); Table Mountain, June 29, 1895 (No. 1368).

Potentilla Hippiana pulcherrima, Watson, Proc. Am. Acad. viii, 555 (1873). *Potentilla pulcherrima*, Lehm.

This is not common, and seems to have affinities with *P. gracilis*, *P. Pennsylvanica* and *P. Hippiana*.

La Plata Mines, August 22, 1895 (No. 1789).

Potentilla humifusa, Nutt. Gen. i, 330 (1818).

Common early in the year on gravelly hillsides.

Laramie Hills, June 2, 1894 (No. 99); May 18, 1895 (No. 1216).

Potentilla Norvegica, L. Sp. Pl. 499 (1753). *P. Monspeliensis*, L.

Apparently throughout the state.

Platte River and Willow Creek, July 1894 (Nos. 502 and 565); Laramie, September 16, 1894 (No. 1143); Cummins, July 30, 1895 (No. 1474).

Potentilla Pennsylvanica, L. Mant. 76 (1767).

Observed but once.

Bessemer, on the Platte River, July 26, 1894 (No. 612).

Potentilla Pennsylvanica strigosa, Pursh, Fl. Am. Sept. 356 (1814).

In rather dry valleys; more frequent than the species.

Whalen Canon, July 18, 1894 (No. 525); Cummins, July 30, 1895 (No. 1545).

Potentilla Plattensis, T. & G. Fl. i, 439 (1838).

On sandy flats bordering on streams.

Horse Creek, June 9, 1894 (No. 206); Laramie River, June 19, 1894 (No. 265).

Potentilla pinnatisecta, n. sp.

This form should not have been suppressed. In Watson's King's Report it appears as *P. diversifolia pinnatisecta.* The points upon which he based the variety are well taken but not strongly enough emphasized. The following, it seems to me, justify the separation of this form from *P. Plattensis* as a distinct species. *P. Plattensis* has been repeatedly observed but only on bottom lands near streams and, I think, thus far, with one exception,* only on streams tributary to the Platte. *P. pinnatisecta* is strictly alpine. The specimens before me were collected on the naked summits of the Medicine Bow Mountains, above timber line at about 11,500 feet, growing among the rocks in the most bleak and barren places.

The two differ markedly in habit as well as in habitat. *P. Plattensis* is decumbent at base, with branches diffuse or loosely spreading. *P. pinnatisecta,* while its branches are slightly decumbent at base, yet the plant as a whole may be spoken of as strictly erect. The cymes are more regular and more open. The leaves are longer, leaflets less crowded and inclined to be pedately parted rather than pinately, strictly cuneate at base. Leaves largely radical, those on the stem greatly reduced. Petioles and stems nearly glabrous with a brownish glaucus hue. Leaves glabrous on the upper surface, softly silky villous on the lower. The plant 5-8 inches high.

Potentilla supina, Michx. Fl. Bor. Am. i, 304 (1803). *P. paradoxa,* Nutt.

Not of frequent occurrence; Hartville, July 16, 1894 (No. 555); Cummins, July 28, 1895 (No. 1525).

Sibbaldia procumbens, L. Sp. Pl. 284 (1753).

Frequent at high altitudes, 10,000 ft. and upward. Union Peak, August 13, 1894 (No. 1010); La Plata Mines, August 23, 1895 (No. 1799).

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*Bot. Death Valley Exped. Contrib. Natl. Herb. iv, 112 (1893.

Chamærhodos erecta, Bunge. Ledeb. Fl. Alt. i, 431.

Observed but once but then in the greatest abundance, on a sand-bar of the Laramie River, June 18, 1894 (No. 261).

Agrimonia Eupatoria, L. Walt. Fl. Car. 131 (1788). *A. Striata,* Michx.

Not at all common; Laramie Peak, on a wooded stream, August 9, 1895 (No. 1653).

Rosa acicularis, Lindl. Ros. Monog. 44, t. 8 (1820).

Found most frequently at the foot of dry, clayey creek banks.

Pole Creek, June 2, 1894 (No. 134); Centennial Valley, August 18, 1895 (No. 1697).

Rosa Arkansana, Porter, Syn. Fl. Col. 38 (1874).

A fine species often met with in wet ravines in the mountains.

Mexican Mines, July 20, 1894 (No. 567); Table Mountain, June 30, 1895 (No. 1336).

Rosa blanda, Ait. Hort. Kew. ii, 202 (1779).

Rather common in canons and the adjacent hillsides.

Whalen Canon, July 18, 1894 (No. 520); Table Mountain, June 30, 1895 (No. 1343).

Rosa Fendleri, Crepin, Prim. Monog. Ros. 452 (1874).

Probably quite rare in the state,

Boulder Creek, August 27, 1894 (No. 1101).

Rosa Sayi, Schwein. Keating, Long's Exped. Appx. 113.

I note that recently this has been made a synonym for *R. acicularis*, but in Watson's Rev. Ros. N. A. 340 (1885), the two forms are kept distinct. If the two forms before me are correctly determined he is amply justified in doing so.

Table Mountain, June 30, 1895 (No. 1643). Also by B. C. Buffum, June 6, 1892.

Rosa Woodsii, Lindl. Ros. Monog. 21 (1820).

A small form, common, in the dry hills and sandy ravines, inclined to be prostrate.

Laramie Hills, June 12, 1894 (No. 242).

Pyrus sambucifolia, Cham. & Schlecht. Linnæa, ii, (1827). *Sorbus sambucifolia,* Roem.

Rather rare; Teton Mountains, August 22, 1894 (No. 982); also from the Centennial Valley, by B. C. Buffum.

Cratægus Douglasii, Lindl. Bot. Reg. 21, t, (1810).

Very scarce, only a few specimens observed in one locality. These are not typical, yet can hardly belong to the following species though approaching it more closely than any other.

Casper, July 25, 1894 (No. 606). *Hawthorn.*

Cratægus rivularis, Nutt. T. & G. Fl. i, 464 (1840).

Of rather frequent occurrence on some streams.

Gros Ventre River August 22, 1894 (No. 1066).

Amelanchier alnifolia, Nutt. Journ. Acad. Phila. viii, 22 (1834).

Very common in the foothills and along streams.

Telephone Canon, June 2, 1894 (No. 117).

Amelanchier pumila, Nutt. Roem. Syn. Monog. iii, 145.

Prof. E. L. Greene, of Catholic University, Washington, D. C., writes me that in 1893 I sent him some material as *A. alnifolia*, which, on examination, proves to be the long suppressed *A. pumila* of which he writes as follows: "It may be recognized by its being perfectly glabrous; by having much longer and narrower petals and by having its leaves serrate almost from base to apex, whereas *A. alnifolia* has its leaves serrate only from the middle upwards."

On examination of the material in our herbarium I find that our 1893 material answers to this description of *A. pumila* perfectly.

Laramie Hills, May 1893. *Service Berry.*

SAXIFRAGACEÆ.

Saxifraga bronchialis, L. Sp. Pl. i, 400 (1753).

Teton Mountains, at high elevations, August 21, 1894 (No. 976).

Saxifraga Jamesii, Torr. Ann. Lyc. N. Y. ii, 204.

This rare species was observed but once. Jackson's Hole, August 22, 1894 (No. 971).

Saxifraga integrifolia, Hook. Fl. Bor. Am. i, 249 (1834).

Grassy places in the mountains, but not at all common.

Bald Mountain, August 16, 1892, B. C. Buffum; Union Pass, August 10, 1894 (No. 930).

Saxifraga nivalis, L. Sp. Pl. i, 401 (1753).

This species is not strictly alpine if this idea be represented solely by altitude. Common, and blossoming in May at 7,000 ft., and successively throughout the season at higher and higher altitudes.

Wind River Mountains, July 20, 1892, B. C. Buffum; Pole Creek, June 2, 1894 (No. 127); La Plata Mines, August 22, 1895.

Saxifraga punctata, L. Sp. Pl. 401 (1753).

Frequent in wet, shaded ravines at high elevations.

Union Pass, August 12, 1894 (No. 843), also from Bald Mountain, by B. C. Buffum.

Saxifraga Virginiensis, Michx. Fl. Bor. Am. i, 269 (1803).

This is less common than *S. nivalis* which it closely resembles.

In the lower valleys of the state. Bald Mountain, August 15, 1892, by B. C. Buffum.

Tellima tenella, Walp. Rept. ii, 371 (1843).

Rare, on the sandy slopes of valleys.

Horse Creek, June 11, 1892; Bald Mountain, August 15, 1892, B. C. Buffum.

Mitella pentandra, Hook. Bot. Mag. lvi, t. 2933 (1829).

Frequent in damp ravines in the mountains.

Teton Mountains, August 21, 1894 (No. 944); Laramie Peak, August 8, 1895 (No. 1623).

Mitella trifida, Graham. var. **integripetala,** Rose.

This new variety is founded upon material collected by B. C. Buffum, and sent by myself to Dr. J. N. Rose, who named it and I suppose published it, but I am unable to cite the publication. It differs from the species mainly in its entire petals and its leaves, which are incisely dentate rather than crenate dentate. Certainly very rare.

Bald Mountain, August 15, 1892.

Heuchera parviflora, Nutt. T. & G. Fl. i, 581 (1838).

Very common on stony ridges and hillsides in the Laramie range.

Pole Creek, June 2, 1894 (No. 163); Table Mountain, June 28, 1895 (No. 1344); also observed in the Medicine Bow Mountains, August 1895.

Parnassia fimbriata, Banks, in Koenig & Sims, Ann. Bot. i, 391 (1805).

Along streams and in wet thickets at high altitudes.

Head of Green River, August 26, 1894 (No. 1034); La Plata Mines, August 22, 1895 (No. 1803).

Parnassia palustris, L. Sp. Pl. 273 (1753).

Quite rare and not readily distinguished from the next except by the cordate leaves.

Bald Mountain, August 16, 1892, B. C. Buffum.

Parnassia parviflora, D C. Prodr. i, 320.

Rather common on grassy stream banks almost in the water.

Fort Washakie, August 5, 1894 (No. 746).

Jamesia Americana, T. & G. Fl. i, 593 (1840).

A very handsome shrub when in blossom. Rare; in rocky canons.

From Saratoga by B. C. Buffum, June 1892; Table Mountain, July 1, 1895 (No. 1418).

Ribes aureum, Pursh, Fl. 164 (1814).

Common in the canons of the Platte, where the black fruited form seems to predominate. Introduced in Laramie as an ornamental shrub.

Fairbanks, July 18, 1894 (No. 571). *Missouri* or *Flowering Currant.*

Ribes aureum chrysococcus, Rydberg, Fl. Neb. xxi, 71 (1895).

Mr. Rydberg founds this variety upon the character of the fruit. It is what has been called the yellow fruited form of the preceding. Noted by Mr. Rydberg, it may again be stated that there is no discernible difference between the flowers and leaves of the two forms, but the fruits are strikingly different, and apparently the difference is constant. The variety is very common in the Platte canons at Fairbanks and produces large, finely flavored berries in abundance, which are gathered in large quantities for domestic use by the residents of the place.

Fairbanks, July 18, 1894 (No. 571a). *Yellow Currant.*

Ribes cereum, Dougl. Trans. Hort. Soc. Lond. vii, 512 (1830).

Exceedingly common on dry, rocky hillsides throughout the state.

Laramie Hills, May 16, 1894 (No. 30); May, 1895 (No. 1231).

Ribes divaricatum, Dougl. Trans. Hort. Soc. Lond. vii, 515 (1830).

Presumably rare; Union Pass, Aug. 10, 1894 (No. 862).

Ribes divaricatum irrigum, Gray, Am. Naturalist, x, 273.

Growing in great profusion in the copses bordering stream banks and producing an abundance of very acid but pleasantly flavored fruit.

Pole Creek, June 2, 1894 (No. 96). Observed in many other parts of the state, but the borders of Wallace Creek may be spoken of as one immense *Gooseberry* patch.

Ribes floridum, L'Her. Stirp. i, 4 (Ehrh. Beitr. vi. 119).

Observed but once; Whalen Canon, July 18, 1894 (No. 541).

Ribes lacustre, Poir. Encycl. Suppl. ii, 856 (1811).

Very common in copses on canon streams.

Teton Mountains, August 21, 1894 (No. 938); Centennial Valley, fls. June 9, 1895 (No. 1556); fr. August 17, 1895 (No. 1689).

Ribes lacustre parvulum, Gray, Bot. Cal. i, 206 (1876).

Frequent in wet thickets at subalpine stations.

Union Peak, August 13, 1894 (No. 1022); LaPlata Mines, August 23, 1895 (No. 1801).

Ribes lacustre molle, (?) Gray, Bot. Cal. i, 206 (1876).

My specimens are clearly a variety of *R. lacustre*, but as I have no description of this variety I put it here tentatively. It has larger fruits and is more softly pubescent than the species.

Union Pass, August 13, 1894 (No. 1073).

Ribes leptanthum, Gray, Pl. Fendl. 53 (1849).

This horridly prickly form must be very rare in the state for, though it is naturally conspicuous, I have observed it but once.

Garfield Peak, July 29, 1894 (No. 695).

Ribes oxyacanthoides, L. Sp. Pl. 201 (1753).

Collected only in one locality, and probably confined to the eastern part of the state.

Pole Creek, June 2, 1894 (No. 129).

Ribes oxyacanthoides saxosum, (Hook.) Coville, Contrib. Natl. Herb. iv, 100 (1893).

This I at first thought the same as the preceding, but on comparing my specimens with 'description, l. c., I find that they must be referred to this variety.

Bacon Creek, August 25, 1894 (No. 1044).

Ribes sanguineum variegatum, Wats. Bot. King Surv. 100 (1871).

Union Pass, August 10, 1894 (No. 860).

CRASSULACEÆ.

Sedum Douglasii, Hook. Fl. Bor. Am. i, 228.

Rare; collected at Wheatland, June 11, 1891, B. C. Buffum.

Sedum rodanthum, Gray, Am. Journ Sci. ii, 33. 405.

In wet bogs in the mountains; subalpine.

Union Pass, August 13, 1894 (No. 929); La Plata Mines, August 23, 1895 (No. 1703).

Sedum stenopetalum, Pursh Fl. i, 324 (1814).

Exceedingly abundant on rocky slopes in the foothills.

Laramie Hills, July 7, 1894 (No. 351); Table Mountain, June 29, 1895 (No. 1467).

HALORAGEÆ.

Hippuris vulgaris, L. Sp. Pl. 4 (1753).

Not at all common; in a muddy bog in Lander, August 3, 1894 (No. 694).

Callitriche palustris, L. Sp. Pl. 969 (1753).

In shallow ponds and pools; rather frequent.

Near Green River, August 25, 1894 (No. 1102); Centennial Valley, August 25, 1895 (No. 1860).

Myriophyllum verticillatum, L. Sp. Pl. 992 (1753).

Green River, August 26, 1894 (No. 1038).

ONAGRACEÆ.

Epilobium adenocaulon, Hausskn. Oest. Bot. Zeitschr. xxix (1879).

Common about springs and wet places.

Laramie, August, 1891, B. C. Buffum; Whalen Canon, July 19, 1894 (No. 545); Lander Creek, August 31, 1894 (No. 1107).

Epilobium brevistylum, Barbey, Brewer & Wats. Bot. Cal. i, 220 (1876).

This specimen I had called *E. affine*, but a closer study of text and plate in Rev. Epilobium by Trelease leads me to believe that these specimens belong to the above.

Wind River Mountains, August 11, 1894 (No. 852).

Epilobium delicatum, Trelease, Mo. Bot. Garden Rep. ii, (1891).

Of the two specimens before me, the one seems nearly typical, the other is rather large flowered but too immature for close comparison.

Cummins, July 30, 1895 (No. 1466); Bald Mountain, August 15, 1892, B. C. Buffum.

Epilobium Hornemanni, Reichenb. Icon. Crit. ii, 73 (1824).

Again I have two specimens, one typical except that it is very dwarf; the other with leaves sessile instead of short petiolate. However, I am unable to refer them to any other species.

Bald Mountain, August 15, 1892; LaPlata Mines, August 23, 1895 (No. 1797).

Epilobium latifolium, L. Sp. Pl. i, 347 (1753). *Chamænerion latifolium* (L.) Sweet.

A rare and handsome species. The specimens before me may possibly be var. *grandiflorum*, Britton.

On a steep clay bank of the Gros Ventre River, August 16, 1894 (No. 1081).

Epilobium paniculatum, Nutt. T. & G. Fl. i, 490 (1840).

Common on sandy soil among small undershrubs on stream banks.

Wallace Creek, July 28, 1894 (No. 643); Cummins, July 28, 1895 (No. 1456).

Epilobium spicatum, Lam. Fl. Fr. iii, 482 (1778). *Chamænerion angustifolium*, (L.) Scop.

Common in the mountains, especially in districts recently burned over.

Garfield Peak, July 29, 1894 (No. 691). *Fire Weed.*

Epilobium suffruticosum, Nutt.

Large typical specimens were obtained on a dry, rocky creek bed.

Warm Spring Creek, August 10, 1894 (No. 798).

Clarkia Pulchella, Pursh, Fl. i, 260, t. 11 (1814).

Probably rare; specimens received from Snake River, May 29, 1892, collected by Fred McCullough.

Gayophytum racemosum, T. & G. Fl. i, 514 (1840).

This and the following species grow in the greatest profusion in the hills, in similar habitats, viz., dry banks, hillsides and ravines.

Sybille Creek, July 8, 1894 (No. 310); Table Mountain, July 1, 1895 (No. 1371); observed in many other localities.

Gayophytum ramosissimum, T. & G. Fl. i, 513 (1840).

Saratoga, June 23, 1893; Sybille Creek, July 8, 1894 (No. 308).

Œnothera albicaulis, Nutt. Fraser's Cat. 1813. *Anogra pallida*, Britton.

Common on sandy ridges along the Laramie River.

Fisher's Ranch, June 19, 1894 (No. 264); Whalen Canon, July 17, 1894 (No. 511).

Œnothera biennis, L. Sp. Pl. 346 (1753). *Onagra biennis* (L.) Scop.

The specimens before me show considerable variation, but none of them seem to fall into any of the existing varieties.

Whalen Canon, July 18, 1894 (No. 519); Laramie Peak, August 8, 1895 (No. 1646).

Œnothera brachycarpa, Gray, Pl. Wright, i, 70.

On gravelly hillsides in the mountains; not frequent.

Centennial Valley, June 9, 1895 (No. 1274); Gros Ventre River, August 16, 1894 (No. 926).

Œnothera breviflora, T. & G. Fl. i, 506 (1840).

This was found in considerable abundance in one spot only, the naked soil of an old buffalo wallow.

Bacon Creek, August 25, 1894 (No. 1043).

Œnothera cæspitosa, Nutt. Gen. i, 246 (1818).

Abundant on the naked red clay hills near Laramie; May 23, 1894 (No. 58); May 30, 1895 (No. 1221).

Œnothera coronopifolia, T. & G. Fl. N. A. i, 495 (1840). *Anogra coronopifolia*, (T. & G.) Britton.

Common on the Laramie Plains.

University Campus, June 1894 (No. 222); June 1895 (No. 1426).

Œnothera Hartwegi, Benth. Pl. Hartw. v, (1843).

On dry, gravelly clay hills; not common.

Blue Grass Creek, July 9, 1894 (No. 375).

Œnothera Hartwegi lavandulæfolia, Watson, Proc. Am. Acad. viii, 590 (1873).

These specimens are from type locality, viz., "Plains of the Platte." Seemingly quite rare.

Whalen Canon, July 18, 1894 (No. 526).

Œnothera pinnatifida, Nutt. Gen. i, 245 (1818). *Anogra albicaulis*, (Pursh) Britton.

Frequent on sandy river bottoms.

Wheatland, July 9, 1894 (No. 380); North Fork Wind River, August 9, 1894 (No. 779).

Œnothera serrulata, Nutt. Gen. i. 246 (1818). *Meriolix serrulata,* (Nutt.) Walp.

Infrequent; Orin Junction, August 14, 1891, B. C. Buffum; Whalen Canon, July 18, 1894 (No. 524).

Œnothera trichocalyx, Nutt. T. & G. Fl. i, 494 (1840).

Particularly rare in the state; only a few specimens secured.

Bull Lake Creek, August 8, 1894 (No. 730).

Œnothera triloba, Nutt. Journ. Acad. Phil. ii, 118 (1821). *Lavauxia triloba,* (Nutt.) Spach.

Gaura coccinea, Nutt. Fraser's Cat. (1813).

A common weed everywhere.

Uva, July 10, 1894 (No. 367); Laramie, July 24, 1895 (No. 1430).

Gaura parviflora, Dougl. Hook. Fl. Bor. Am. i, 208 (1833).

Belonging to the lower altitudes of the state.

Two Bar Ranch, Blue Grass Creek, July 9, 1894 (No. 376).

LOASACEÆ.

Mentzelia albicaulis, Dougl. Hook. Fl. Bor. Am. i, 222 (1833).

In sandy thickets along streams or on hillsides.

Grant, on Sybille Creek, July 8, 1894 (No. 336); Cummins, July 28, 1895 (No. 1471).

Mentzelia chrysantha, Engelm.

This is probably rare, as only a few specimens were observed. No citations are at hand; reported from Canon City, Colo., and southern Utah in Coulter's Manual.

Big Wind River, August 5, 1894 (No. 705).

Mentzelia dispersa, Watson, Proc. Am. Acad, xi, 115 and 137.

Common in dry ravines in the hills.

Table Mountain, June 30, 1895 (No. 1375); Cummins, July 28, 1895 (No. 1455).

Mentzelia lævicaulis, T. & G. Fl. N. A. i, 535 (1840).

In disintegrated eruptive rock, Garfield Peak, July 29, 1894 (No. 678).

Mentzelia Nelsonii, Greene, Erythea, iii, 70 (1895).

The following is the original description: "Annual, 2 or 3 feet high, freely and widely branching, the stoutish branches with a sparingly hispidulous whitish bark; lower leaves unknown, those of the branches from distinctly hastate-ovate to almost deltoid-ovate, 1 or 2 inches long, coarsely toothed or indistinctly lobed, both faces green and rather sparsely appressed-hispidulous, the hairs of the upper surface stouter and more enlarged at base; flowers many, small, orange-colored, sessile, or nearly so, in the forks and axils; ovary subcylindric, less than one-half inch long at flowering time and after; calyx-lobes slenderly subulate at flowering, almost as long as the ovary; petals 5 only, about 4 lines long; stamens few; filaments filiform; anthers suborbicular; capsule and seeds unknown. A very well marked species, certainly allied to the Mexican *M. aspera*, but much larger and more diffusely branching, the leaves relatively broader."

It is probably quite local; collected in a canon leading to the Platte River, July 13, 1894 (No. 439).

Mentzelia nuda, T. & G. Fl. N. A. i, 535 (1840).

Frequent, and always in abundance; sandy plains and hillsides; somewhat variable as to habit.

Big Sandy, July 18, 1892; Grant, July 8, 1894 (No. 338); Cummins, July 29, 1895 (No. 1470).

Mentzelia ornata, T. & G. Fl. N. A. i, 534 (1840).

Also common on sandy foothills near the Platte and its tributaries.

Fairbanks, July 14, 1894 (No. 486); Big Horn Mountains, August 5, 1892.

Mentzelia pumila, T. & G. l. c.

On a stony, gravelly hillside, Cummins, July 29, 1895 (No. 1436).

CACTACEÆ.

It is not at all probable that the following numbers represent at all adequately our *Cactaceæ*, but the difficulty of preparing good specimens has caused them to be neglected.

Cactus viviparus, Nutt. in Fraser's Cat. (1813).

This is exceedingly rare; only two plants thus far observed.

Ione Ranch, on Laramie River, August 10, 1895 (No. 1865).

Echinocactus Simpsoni, Engelm. Trans. St. Louis Acad. ii, 197 (1863).

Frequent on the plains and in the valleys of the Laramie range.

Laramie, June 15, 1894 (No. 75).

Cereus viridiflorus, Engelm. Pl. Fendl. 50 (1849).

Rare, seemingly confined to the east slopes of the Laramie range. Pole Creek, June 2, 1894 (No. 113).

Opuntia fragilis (?) Haw. Suppl. Pl. Succ. 82 (1819).

A few specimens from Fairbanks, on the Platte, are thought to belong here. July 14, 1894 (No. 465).

Opuntia polyacantha platycarpa, (Engelm.) Coulter, Contrib. Natl. Herb. (III) vii, 436 (1896).

Probably several varieties of this species are found on our plains, but no specimens are at hand except of this. On the dry, gravelly plains the species, in some form, is immensely abundant, forming in places almost continuous beds.

Table Mountain, June 2, 1894 (No. 115).

UMBELLIFERÆ.

Sanicula Marylandica, L. Sp. Pl. 235 (1753).

Rare in the parts of the state collected, but probably frequent in the northeast.

Laramie Peak, August 8, 1895 (No. 1607).

Musenium tenuifolium, Nutt. T. & G. Fl. N. A. i, 642 (1840). *Adorium tenuifolium,* (Nutt.) Kuntze.

Usually reported as rare, but it is found in the greatest profusion in the Laramie range, on rocky ridges. June 7, 1894 (No. 176); Platte Hills, July 11, 1894 (No. 391).

Musenium trachyspermum, Nutt. l. c.

Common on the Laramie plains, appearing very early.

Laramie, May 7, 1894 (No. 10); observed outside of Laramie but not collected.

Bupleurum Americanum, C. & R.

Seemingly quite rare ; a fine species.

Union Pass, August 14, 1894 (No. 893).

Bupleurum ranunculoides, L. Sp. Pl. 237 (1753).

Judging by place of collection, this may be denominated alpine.

Teton Peaks, August 21, 1894 (No. 972).

Harbouria trachypleura, C. & R.

Frequent in fertile mountain valleys at 7,000-8,000 ft.

Table Mountain, June 2, 1894 (No. 160); Saw Mill Creek, May 25, 1895 (No. 1238).

Cicuta maculata, L. Sp. Pl. 256 (1753).

In wet places along streams, particularly in the lower altitudes.

Lusk, July 21. 1894 (No. 573); Meadow Creek, August 9, 1894 (No. 790); Laramie River, near lone Ranch, August 10, 1895 (No. 1557).

Carum Gairdneri, B. & H. Gen. Pl. i, 891.

In fertile valleys in the mountains, particularly such as are partially covered with undershrubs. The "Yamp" of the Indians.

Garfield Peak, July 29, 1894 (No. 660); Gros Ventre River, August 18, 1894 (No. 1096).

Zizia cordata, DC. Prodr. iv, 100 (1830).

Along streams and on moist hillsides even to their summits.

Horse Creek, June 9, 1894 (No. 204); Pole Creek, June 29, 1895 (No. 1327).

Sium cicutæfolium, Gmelin. Syst. ii, 482 (1791).

In the margins of fresh water lakes and ponds.

Bull Lake, August 8, 1894 (No. 731); Laramie River, August 10, 1895 (No. 1665).

Osmorrhiza nuda, Torr. Pac. Rep. iv, 93 (1857).

In copses along most of our streams.

Garfield Peak, July 29, 1894 (No. 650); Centennial Valley, August 19, 1895 (No 1722).

Cymopterus montanus, T. & G. Fl. N. A. i, 624 (1840).

One of the earliest plants on the plains and hills.

Laramie, May 7, 1894 (No. 9); specimens from previous years also in the herbarium.

Ligusticum apiifolium, Benth. & Hook. Gen. Pl. i, 912.

A species with handsome foliage, quite rare.

Union Pass, August 11, 1894 (No. 832).

Ligusticum filicinum, Watson, Proc. Am. Acad. xi, 140.

These specimens were not secured until after most of the fruit had fallen off, but the remaining fruits and foliage made satisfactory determination possible.

Gros Ventre river, August 18, 1894 (No. 1095).

Ligusticum scopulorum, Gray, Proc. Am. Acad. vii, 347 (1868).

Fine specimens were collected at an unusual altitude, nearly 11,000 ft.

La Plata Mines, August 23, 1895 (No. 1784).

Ligusticum, sp.

The plants represented by numbers 1610 and 1655 are too immature to render determination certain, but Dr. Rose, to whom they were submitted, thinks it probable they are distinct species.

Oreoxis humilis, Raf.

Rare; Cummins, July 30, 1895 (No. 1431).

Selinum Grayi, C. & R.

In wet places at high elevations.

La Plata Mines, August 21, 1895 (No. 1776).

Angelica pinnata, Watson, King's Rep. v, 126 (1871).

Infrequent; along streams at 7,000-8,000 ft.

Upper Wind River, August 10, 1894 (No. 755).

Peucedanum graveolens, (?) Watson, King's Rep. v, 128 (1871). *P. Kingii,* Wats.

The material is scanty and over-ripe, but there is little doubt as to the correctness of the determination.

Garfield Peak, July 29, 1894 (No. 649).

Peucedanum nudicaule, Nutt. T. & G. Fl. N. A. i, 627 (1840).

Everywhere in the foothills, the naked scapes shooting up almost before the snow is off the ground.

Laramie, May 4, 1894 (No. 6); also on Horse Creek, June 6,1893.

Peucedanum simplex, Nutt. Wats. King Rep. v, 129 (1871).

Only a few specimens secured.

Union Pass, August 11, 1894 (No. 822).

Pastinaca sativa, L. Sp. Pl. 262 (1753).

Introduced at Cheyenne, where it was collected by B. C. Buffum, August 11, 1891. *Wild Parsnip.*

Heracleum lanatum, Michx. Fl. Bor. Am. i, 166 (1803).

On all streams, growing in the greatest profusion in the thickets at the water's edge.

Horse Creek, July 11, 1891; collected also high up on the Tetons, August 21, 1894 (No. 1055).

ARALIACEÆ.

Aralia hispida, Vent. Hort. Cels. t. 41.

The herbarium contains a single specimen collected by B. C. Buffum in 1892, no locality given. It most probably is from the north-eastern part of the state.

CORNACEÆ.

Cornus stolonifera, Michx. Fl. i, 92 (1803).

An exceedingly common shrub in thickets on most of our streams.

Wallace Creek, July 29, 1894 (No. 663); Little Sandy, August 31, 1894 (No. 1125); Table Mountain, July 1, 1895 (No. 1407).

CAPRIFOLIACEÆ.

Sambucus melanocarpa, Gray, Proc. Am. Acad. xix, 76 (1883).

Frequent in rocky canons throughout the state.

Telephone Canon, June 15, 1894, (No. 253); Union Peak, August 13, 1894 (No. 1026); Centennial Valley, August 18, 1895 (No. 1690).

Viburnum pauciflorum, Pylaie. T. & G. Fl. N. A. ii, 17 (1841).

Reported abundant near Sundance, specimens communicated by Mr. H. J. Chassel, September 1, 1895.

Symphoricarpos occidentalis, Hook. Fl. Bor. Am. i, 285 (1834).

On sandy creek banks as an undershrub in the thickets.

Blue Grass Creek, July 8, 1894 (No. 324); Laramie Peak, August 8, 1895 (No. 1565).

Symphoricarpos oreophilus, Gray; Journ. Linn. Soc. & Bot. Calif.

In the hills and mountains only at considerable elevations.

Casper Mountain, July 26, 1894 (No. 608); Cummins, July 29, 1895 (No. 1509).

Symphoricarpos racemosus pauciflorus, Robbins, Gray, Man. Ed. 5, 203 (1867). *S. pauciflorus,* (Robbins) Britton.

A few specimens secured on the eastern slope of the Tetons, August 21, 1894 (No. 958).

Lonicera involucrata, Banks, Richards. Bot. App. Ed. 2, 6 (1823).

Very common on little mountain streams; frequently called *Grouse Berries.*

Upper Wind River, August 10, 1894 (No. 758); Cummins, July 30, 1895 (No. 1482).

Lonicera Utahensis, Wats. Bot. King Surv. 133 (1871).

This I think to be very rare in the state.

Teton Mountains, August 21, 1884 (No. 934).

RUBIACEÆ.

Galium boreale, L. Sp. Pl. 108 (1753).

On every fertile mountain hillside and every valley in the greatest profusion.

Sybille Creek, July 8, 1894 (No. 343); Table Mountain, June 30, 1895 (No. 1384).

Galium trifidum, L. Sp. Pl. 105 (1753).

Common in wet places, as on the occasionally flooded banks of slow flowing streams.

Silver Creek, August 24, 1894 (No. 1115); Centennial Valley, August 19, 1895 (No. 1763).

Galium triflorum, Michx. Fl. i, 80 (1803).

Not common, collected on a wet, shaded hillside.

Centennial Valley, August 17, 1895 (No. 1693).

VALERIANACEÆ.

Valeriana edulis, Nutt.; Torr & Gray, Fl. ii, 48 (1841).

Very plentiful in the wet meadows bordering the Laramie River.

Fisher Ranch, June 19, 1894 (No. 262).

Valeriana Sitchensis, Bong. Veg. Sitch. 145.

Fine specimens were secured at Clark's, but not observed elsewhere.

Upper Wind River, August 10, 1894 (No. 793).

Valeriana sylvatica, Banks; Richards Bot. App. 730 (1823).

On wooded hillsides and in wet valleys in the Laramie Mountains. This species is very abundant.

Telephone Canon, June 15, 1894 (No. 228). Observed in a large number of other places.

COMPOSITÆ.

Brickellia grandiflora, Nutt. Trans. Am. Phil. Soc. vii, 287 (1841).

Coleosanthus grandiflorus, (Hook.) Kuntze.

Frequent on hillsides near the Platte and its tributaries.

Fairbanks, July 10, 1894 (No. 423); Cummins, July 30, 1895 (No. 1687).

Kuhnia eupatorioides, L. Sp. Pl. Ed. 2. 1662 (1763).

Infrequent; Laramie, September 1893.

Kuhnia eupatorioides corymbulosa, T. & G. Fl. N. A. ii, 78 (1841). *K. glutinosa,* Ell.

Probably confined to the eastern part of the state.

Cliffs, near Cold Spring, July 14, 1894 (No. 457).

Liatris punctata, Hook. Fl. Bor. Am. i: 306, t. 55 (1833). *Lacinaria punctata,* (Hook.) Kuntze.

Abundant in the northern part of Albany and Laramie counties.

Wheatland, June 30, 1892, B. C. Buffum; Laramie Peak, August 7, 1895 (No. 1564).

Liatris scariosa, Willd. Sp. Pl. iii, 1635 (1804). *Lacinaria scariosa,* (L.) Hill.

The range of this is about the same as the last but it prefers the rich loam of the valleys.

Inyan Kara Divide, August 30, 1892, B. C. Buffum; Laramie Peak, August 8, 1895 (No. 1651).

Liatris squarrosa intermedia, D C. Prodr. v, 129 (1836). *Lacinaria squarrosa intermedia,* (Lindl.) Porter.

Apparently quite local, in the northern part of Laramie county.

Rawhide Creek, September 4, 1892, B. C. Buffum; Mexican Mines, July 20, 1894 (No. 588).

Gutierrezia Euthamiæ, T. & G. Fl. N. A. ii, 193 (1841). *G. Sarothrae,* (Pursh) Britton & Rusby.

The most prevalent of our small undershrubs, particularly on the plains.

University Campus, September 12, 1894 (No. 1133); frequent also on the plains of the Platte.

Grindelia squarrosa,. Dunal in D C. Prodr. v, 315 (1836).

Abundant in all parts of the state thus far traversed.

Meadow Creek, August 9, 1894 (No. 777); Laramie, September 16, (No. 1148).

Chrysopsis villosa, Nutt. Gen. ii, 151 (1818).

In this polymorphous species, with so many intermediate forms, it becomes difficult to say which should receive varietal names. Some of the specimens before me, however, are typical.

Platte River, July 14, 1894 (No. 481); Hartville, July 18, 1894 (No. 585), a very villous form.

Chrysopsis villosa canescens, Gray, Syn. Fl. 123 (1886).

The commoner form in the north-western part of the state.

Gros Ventre River, August 16, 1894 (No. 1084); also observed in the Teton Mountains.

Chrysopsis villosa hispida, Gray, Proc. Acad. Phila. 1863, 65.

This is the form prevalent on the plains about Laramie,

State Fish Hatchery grounds, July 1891, B. C. Buffum.

Chrysopsis villosa viscida, Gray, Syn. Fl. 123 (1886).

A characteristic mountain form common in the Medicine Bow range.

Cummins, July 28, 1895 (No. 1497).

Aplopappus acaulis, Gray, Proc. Am. Acad. vii, 353.

Frequent and abundant on the Laramie Plains and in the foothills.

Laramie Hills, June 1893; plains, west of Laramie, June 9, 1895 (No. 1250).

Aplopappus acaulis glabratus, Eaton, Bot. King's Exp. 161.

Laramie, 1893. The month not noted, but it was probably collected late in the season.

Aplopappus armerioides, Gray, Syn. Fl. i, 132 (1886). *Stenotus armerioides*, Nutt.

Found only on the "red hills" near Laramie.

June 15, 1894 (No. 227).

Aplopappus Fremonti, Gray, near var. **Wardi,** Gray, Syn. Fl. i. 128.

This fine form I at first thought must be a *Bigelovia* as it was rayless, but Mr. M. L. Fernald, who kindly made comparison for me with the specimens in the Harvard herbarium, finds that my specimens correspond closely with Ward's the main difference being that mine have longer pappus.

Plains, ten miles north of Laramie, August 1, 1895 (No. 1553).

Aplopappus lanceolatus, T. & G. Fl. ii, 241.

Frequent on grassy slopes and in the valleys of the foothills.

Laramie, August 1894; Poison Spider Creek, July 27, 1894 (No. 624).

Aplopappus Lyalli, Gray, Proc. Acad. Phila. 1863, 64.

Quite typical specimens of this fine alpine plant were secured.

Union Pass, August 13, 1894 (No. 1012).

Aplopappus Nuttallii, T. & G. Fl. N. A. ii, 242 (1842). *Eriocarpum Grindelioides*, Nutt.

Collected on wet alkali flats.

Laramie, October 1893.

Aplopappus Parryi, Gray, Am. Journ Sci. Ser. 2, xxxiii, 10.

In partially shaded woods among the fallen trees.

Centennial Hills, August 17, 1895 (No. 1695).

Aplopappus pygmæus, Gray, Am. Journ. Sci. Ser. 2, xxxiii, 239.

Sparingly found on the bleak, rocky summits of the Medicine Bow Mountains, dwarf and somewhat cæspitose.

La Plata Mines, August 23, 1895 (No. 1875).

Aplopappus spinulosus, D C. Prodr. v, 347 (1836). *Eriocarpum spinulosum*, (Pursh) Greene.

Very abundant, in some localities becoming a weed.

Sheridan Experiment Farm, September 1895, J. F. Lewis; Cold Springs, July 14, 1894 (No. 456).

Aplopappus uniflorus, T. & G. Fl. ii, 241.

So far found only in the north-western part of the state.

Bacon Creek, August 15, 1894 (No. 911); Green River, August 26, 1894 (No. 1035).

***Bigelovia collinus,** (Greene). *Chrysothamnus collinus*, Greene.

For this specimen I am indebted to Prof. Greene. It is quite distinct from all the other forms I have secured.

Rock Springs, August 9, 1895, Prof. E. L. Greene.

Bigelovia Douglasii, Gray, Proc. Am. Acad. viii, 645 (1873).

The determination was made by Dr. Rose, but it should be added that the specimens are somewhat immature, and, as stated by him, not in condition to determine with certainty.

Laramie, 1893.

Bigelovia Douglasii lanceolata, Gray, Syn. Fl. 140 (1886).

I judge the specimens before me to be nearly typical; they come from within the type locality as well.

Union Pass, August 14, 1894 (No. 889); also from Bacon Creek.

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*The nomenclature of this genus is in such a state of confusion, that for the present I adopt that which allows of the quickest and easiest disposition of my material. My library facilities are too meager for me to presume to pass upon the relative merits of Dr. Gray's Bigelovia; Dr. Britton's Chondrophora, and Prof. Greene's Chrysothamnus.

Bigelovia Douglasii pumilla, Gray, Syn. Fl. 140 (1886).

Of frequent occurrence and apparently throughout the state.

In 1894 successively at Garfield Peak, Bacon Creek, Boulder Creek and at Laramie, (Nos. 616, 902, 1121, 1197).

Bigelovia Douglasii Stenophylla, Gray, Proc. Am. Acad. viii, 644 (1873).

Certainly very rare; noted but once.

Centennial Valley, August 26, 1895 (No. 1847).

Bigelovia Douglasii tortifolia, Gray, l. c.

These varieties run so closely together that it is difficult to speak with certainty regarding them.

Poison Spider Creek, July 26, 1894 (No. 617).

Bigelovia graveolens, Gray, l. c.

Good specimens of this were obtained on the Platte. Common in the canons and foothills near the river.

Platte River July 14, 1894 (No. 503).

Bigelovia graveolens albicaulis, Gray, l. c. *Chrysothamnus frigidus,* Greene, Erythea, iii, 112 (1895).

This is by far the most abundant form on the Laramie Plains, where in places it forms an almost uninterrupted growth for miles at a stretch.

Its characteristics are so well marked that Prof. Greene is well justified in raising it to specific rank.

Laramie, August 29, 1891, B. C. Buffum; E. L. Greene, August 1895; Bacon Creek, August 15, 1894 (No. 910).

Bigelovia graveolens glabrata, Gray, l. c.

This variety was observed only on the Pacific slope.

Bacon Creek, August 23, 1894 (No 966); Boulder Creek, August 26, (No. 1120).

Bigelovia Howardii, Gray, Proc. Am. Acad. viii, 641 (1873).

Prof. Greene * notes this form as peculiar to mountain parks of Colorado. This was secured in a similar location in Wyoming.

Centennial Valley, August 26, 1895 (No. 1846).

Bigelovia linifolia, (Greene). *Chrysothamnus linifolius,* Greene.

For this specimen also I am indebted to Prof. Greene; however, on comparing with our material, I find one listed as *B. Douglasii*

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*Erythea, iii, 114.

lanceolata that perfectly accords with it. This I cut out and place here

Rock Springs, August 9, 1895, E. L. Greene; Poison Spider Creek, July 26, 1894 (No. 618).

Solidago Canadensis, L. Sp. Pl. 878 (1753).

Probably confined to the lower altitudes of the eastern part of the state.

C. Y. Ranch, Big Muddy, July 23, 1894 (No. 597).

Solidago elongata, Nutt. Trans. Am. Phil. Soc. n. ser. vii, 328 (1841).

Frequent on the lower courses of mountain streams.

Big Muddy Creek, July 24, 1894 (No. 641); Cummins, July 27, (No. 1479). Also observed on Meadow Creek, 1894.

Solidago humilis nana, Gray, Proc. Am. Acad. viii, 389.

Infrequent, 9,000 ft. and upward.

Centennial Valley, August 18, 1895 (No. 1680).

Solidago Missouriensis, Nutt. Journ. Acad. Phila. vii, 32 (1834).

The species is much rarer with us than the following varieties.

Laramie Peak, August 8, 1895 (No. 1629).

Solidago Missouriensis extraria, Gray, Proc. Am. Acad. xvii, 195.

This seems to be the form on the western slope of the Rockies.

Bacon Creek, August 15, 1894 (No. 912).

Solidago Missouriensis montana, Gray, l. c.

Very common in dry, clayey ravines and on the adjoining hillsides near the Platte and its tributaries.

Uva, July 10, 1894 (No. 382); Cottonwood Canon, August 5, 1895 (No. 1571).

Solidago multiradiata, Ait. Hort. Kew. iii, 218 (1789).

Frequent in the mountains.

Warm Spring Creek, August 10, 1894 (No. 800); LaPlata Mines, August 22, 1895 (No. 1771).

Solidago multiradiata scopulorum, Gray, Proc. Am. Acad. xvii, 191 (1882).

Only a few specimens were secured, at high elevations, probably 10,000 ft.

Teton Mountains, August 22, 1894 (No. 955).

Solidago nana, Nutt. Trans. Am. Phil. Soc. vii, 327.

Not frequent. Upper Wind River, August 10, 1894 (No. 765).

Solidago rigida, L. Sp. Pl. 880 (1753).

Not observed by the writer, but good specimens from the northeastern part of the state.

Suggs Road, August 15, 1892, B. C. Buffum; Sheridan Experiment Farm, September 1895, J. F. Lewis.

Townsendia grandiflora, Nutt. Trans. Am. Phil. Soc. n. ser. vii, 306 (1841).

Frequent on the sandy plains in the eastern part of the state.

Uva, July 9, 1894 (No. 385); Pole Creek, June 30, 1895 (No. 1366).

Townsendia sericea, Hook. Fl. Bor. Am. 119 (1834). *T. exscapa,* (Richards) Porter.

So far as my observation goes, this is the very earliest flower of southeastern Wyoming. Abundant on the plains and in the foothills.

Collected May 5, 1894 (No. 7); observed on several years as early as the first week in April.

Aster adscendens, Lindl. Hook. Fl. Bor. Am. ii, 8 (1834).

I find this as variable as it is common in the state.

Nearly typical specimens from Bacon Creek, Silver Creek, Sweetwater River and Laramie, late August and September (Nos. 1052, 1110, 1196 and 1149).

A very peculiar form from Myersville, September 5, 1894 (No. 1193). This will probably prove to be a good variety at least. Other specimens from Laramie Peak are not typical, but for the present they are placed here. (Nos. 1561 and 1639).

Aster adscendens frondeus, Gray.

The citation for this name, which was communicated to me by Prof. Greene, I am unable to give. The specimens indicate a good variety at least.

Bacon Creek, August 25, 1894 (No. 1049).

Aster adscendens, Lindl. var. ?

Three quite different forms I have listed as possible varieties—No. 892 from Bacon Creek, Nos. 964 and 1092 from Gros Ventre River.

Aster canescens, Pursh. Fl. Am. Sept. 547 (1814). *Machæranthera canescens,* Gray.

The specimens seem hardly typical, but neither are they referable to any of the established varieties.

Bacon Creek, August 15, 1894 (No. 904); Gros Ventre River, August 17, 1894 (No. 1089).

Aster canescens latifolius, Gray, Torr. in Emory Rep. 141.

Infrequent; on eastern slope of partially wooded mountain side.

Laramie Peak, August 7, 1895 (No. 1636).

Aster canescens viridis, Gray, Syn. Fl. 206 (1886).

A very abundant plant on the Laramie Plains, in places a troublesome weed.

University Campus September 15, 1894 (No. 1150).

Aster commutatus, Gray, Syn. Fl. 185 (1884). *A. incanopilosus,* (Lindl.) Sheldon.

Exceedingly abundant everywhere, some of its forms shading off into *A. multiflorus.*

Big Muddy Creek, July 23, 1894 (No. 598); Laramie, October 10, 1894 (No. 1170).

Aster conspicuus, Lindl. Hook. Fl. Bor. Am. ii, 7 (1840).

Infrequent; on a partially wooded slope in the Gros Ventre Mountains, near the Gros Ventre River, August 22, 1894 (No. 1069).

Aster elegans, T. & G. Fl. N. A. ii, 159.

This beautiful species seems to belong to the northeastern part of the state, in partially open hillsides.

Union Pass, August 11, 1894 (No. 826); Gros Ventre, August 22 (No. 1068).

Aster Engelmanni, Gray, Bot. King Surv. 144 (1871).

In a rather open copse on the banks of a canon stream.

Centennial Valley, August 17, 1895 (No. 1691).

Aster foliaceus, Lindl. DC. Prodr. v, 228 (1836).

The specimens are typical except that they are somewhat dwarf.

Wheatland, July 14, 1891, B. C. Buffum.

Aster foliaceus Burkei, Gray, Syn. Fl. 193 (1884).

Three good varieties of this at hand, this one from Little Sandy Creek, August 30, 1894 (No. 1132).

Aster foliaceus Eatoni, Gray, Syn. Fl. 194 (1884).

East Fork, August 25, 1894 (No. 1118).

Aster foliaceus frondeus, Gray, Syn. Fl. 193 (1884).

Centennial Valley, August 25, 1895 (No. 1859).

Aster Fremontii, Gray, T. & G. Fl. N. A. ii, 503.

No data on this specimen except collected near Laramie, October 3, 1891, by B. C. Buffum.

Aster frondosus, T. & G. Fl. N. A. ii, 165. *Brachyactis frondosa,* Gray.

Frequent in low, wet ground, especially in alkali soil, on the hummocks in alkali bogs.

Typical specimens from Laramie, September 7, 1895 (No. 1867); specimens from Seven Mile Lake, October 15, 1894 (No. 1159), remarkable for their size and the great number of large flowers.

Aster glaucus, T. & G. Fl. N. A. ii, 172.

In the foothills of all the mountain ranges yet collected.

Big Wind River, August 10, 1894 (No. 772); Laramie, September 30, 1894 (No. 1151); Laramie Peak, August 7, 1895 (No. 1590).

Aster lævis Geyeri, Gray, Syn. Fl. 183 (1884).

Collected by B. C. Buffum, Eagle Rock Canon, August 22, 1892.

Aster integrifolius, Nutt. Trans. Am. Phil. Soc. n. ser. vii, 291 (1841).

Belonging to the western or Pacific slope, observed only on the west side of Union Pass, August 13, 1894 (No. 1032).

Aster Lindleyanus, T. & G. Fl. N. A. ii, 122.

It was quite a surprise to find this species so far to the south and west.

Laramie Peak, August 6, 1895 (No. 1592).

Aster multiflorus, Ait. Hort. Kew. iii, 203 (1789).

Common throughout the state and quite variable as to habit, hirsuteness and size of flowers.

Big Muddy Creek, July 24, 1894 (No. 642); reported from Sheridan as a weed on the Experiment Farm.

Aster Parryi, Gray, Am. Nat. viii, 212.

This beautiful large flowered species is found in the greatest abundance in some parts of the Laramie Plains as is its congener *A. xylorrhiza.* Usually in separate districts but occasionally striving for the occupancy of the same hillside. Hybrids, I think, sometimes occur, for specimens are found with the characters of both species well blended. Preferring a red clay soil with a percentage of alkali in it.

Carbon, June 18, 1894 (No. 256), Miss Lily Boyd; Laramie Plains, June 20, 1895 (No. 1315).

Aster ptarmicoides, T. & G. Fl. N. A. ii, 160 (1841).

Rare; typical specimens from Bald Mountain, August 16, 1892, B. C. Buffum.

Aster pulchellus, Eaton, Bot. King Exp. 143.

This elegant alpine form occurs at least in the two principal ranges in the northern part of the state.

Bald Mountain, August 8, 1892, B. C. Buffum; Union Peak, August 13, 1894 (No. 1016).

Aster salicifolius, Ait. Hort. Kew. iii, 203.

From Jackson's Hole, near the base of the Teton Mountains, August 21, 1894 (No. 1065).

Aster tanacetifolius, H B K. Nov. Gen. & Sp. iv, 95 (1820).

Frequent on the sandy plains of the Platte. Uva, July 10, 1894 (No. 443). Observed in many other places.

Aster xylorrhiza, T. & G. Fl. N. A. ii, 158

This grows even more profusely than the above mentioned *A. Parryi*, but prefers soil with less alkali. Sandy clay ridges on the height of land between streams.

Laramie Plains, June 20, 1895 (No. 1315).

Erigeron acris, L. Sp. Pl. 863 (1753).

Infrequent and alpine; Laramie Peak, August 7, 1895 (No. 1621).

Erigeron armerifolius, D C. Prodr. v, 291 (1836).

Quite frequent along stream banks.

Head of Green River, August 14, 1894 (No. 908); Cummins, July 29, 1895 (No. 1480).

Erigeron cæspitosus, Nutt. Trans. Am. Phil. Soc. vii, 307 (1841).

Frequent on dry stony hillsides in the Laramie Mountains.

Blue Grass Creek, July 9, 1894 (No. 334); Cummins, July 30, 1895 (No. 1496).

Erigeron Canadensis, L. Sp, Pl. 863 (1753).

Sybille Creek, July 9, 1894 (No. 298); Whalen Canon, July 18, 1894 (No. 556).

Erigeron canus, Gray, Mem. Am. Acad. iv, 67 (1849).

My specimens of this are a little scanty and over ripe, but I think there is little doubt of the correctness of the determination.

Platte Canon, July 14, 1894 (No. 482).

Erigeron compositus, Pursh, Fl. ii, 535 (1814).

Observed only on a clayey, gravelly ridge at the head of Pole Creek, May 12, 1894 (No. 26); May 18, 1895 (No. 1217).

Erigeron compositus pinnatisectus, Gray, Proc. Am. Acad. xvi, 90 (1880).

In the Medicine Bow Mountains only as yet, 10,000 ft. and upward.

La Plata Mines, August 23, 1895 (No. 1816).

Erigeron trifidus, Hook. Fl. Bor. Am. ii, 17 (1834).

Near the summit of Laramie Peak, August 7, 1895 (No. 1612).

Erigeron corymbosus, Nutt. Trans. Am. Phil. Soc. vii. 308 (1841).

This fine mountain form is quite variable as to the number of heads. In three specimens from different localities I find the stems unicephalous, while only one has the typical corymbose arrangement.

Telephone Canon, June 15, 1894 (No. 234); Platte Hills, July 24, 1894 (No. 633); Union Pass, August 10, 1894 (No. 859); Centennial Hills, June 9, 1895 (No. 1290).

Erigeron Coulteri, Porter, in Fl. of Colo., 61.

Just a few fine specimens secured at Cummins, July 28, 1895 (No. 1524).

Erigeron divergens, T. & G. Fl. ii, 175 (1841).

Widely distributed, but not common.

Fine specimens from Snake River, Jackson's Hole, August 22, 1894 (No. 1053). Larger and more divergently branched plants from subalpine slopes on Laramie Peak, August 6, 1895 (No. 1635).

Erigeron flagellaris, Gray Mem. Am. Acad. iv, 68 (1849).

Immature and mature specimens present a very different appearance on account of the great lengthening of the stems without a corresponding increase in the number of leaves. Table Mountain, June 30, 1895 (No. 1386); Laramie Peak, August 6, 1895 (No. 1600).

Erigeron glabellus, Nutt. Gen. ii, 147 (1818). *E. asperus,* Nutt.

Our commonest Erigeron, everywhere abundant in wet meadows, somewhat variable.

Lander Creek, August 29, 1894 (No. 1117); Cummins, July 30, 1895 (Nos. 1454 and 1536). Specimens from several other localities.

Erigeron subtrinervis, Rydberg. *E. glabellus mollis,* Gray.

That this is worthy of the specific rank recently accorded it, I think no one will question.

Centennial Valley, August 17, 1895 (No. 1692).

Erigeron grandiflorus, Hook. Fl. ii, 123.

Bald Mountain, August 15, 1892, B. C. Buffum, specimens with rays almost white; La Plata Mines, August 24, 1895 (No. 1805), rays purple.

Erigeron leiomeris, Gray, Syn. Fl. 211 (1884).

Collected on the Grand Teton at about 10,000 ft , at the foot of rocky ledges, August 21, 1894 (No. 1054).

Erigeron macranthus, Nutt. Trans. Am. Phil. Soc. vii, 310 (1841).

In mountain parks and meadows at 8,000 ft. and upward.

Garfield Peak, July 29, 1894 (No. 647); Cummins, July 30, 1895 (No. 1535).

Erigeron pumilus, Nutt. Gen. ii, 147 (1818).

Frequent in sandy, grassy valleys in the Laramie Mountains.

Laramie Hills, June 7, 1894 (No. 169); Table Mountain, June 30, 1895 (No. 1339); observed in many other localities.

Erigeron radicatus, Hook. Fl. ii, 17.

On dry, stony ridges and subalpine table lands.

State Fish Hatchery grounds, Laramie, May 28, 1892, B. C. Buffum ; Table Mountain, June 2, 1894 (No. 143).

Erigeron salsuginosus, Gray, Proc, Am. Acad. xvi, 93 (1880).

Wyoming must be the natural home of this splendid species, judging by the luxuriance of its growth. Superb specimens with heads two inches in diameter are of frequent occurrence along our mountain streams.

Union Pass, August 12, 1894 (No. 895); Centennial Hills, August 16, 1895 (No. 1775).

Erigeron strigosus, Muhl. Willd. Sp. Pl. iii, 1956 (1804). *E. ramosus,* (Walt.) B. S. P.

Infrequent, Union Pass, August 11, 1894 (No. 851).

Erigeron uniflorus, L. Sp. Pl. 864 (1753).

This, with us, alpine form varies greatly as to size and hirsuteness.

Specimens from Teton Mountains, August 22, 1894 (No. 969), are only 1-2 inches high, the involucre hirsute with sparse light colored hairs. Those from the Medicine Bow Mountains, August 23, 1895 (No. 1772) are 4-6 inches high, stems bearing 4-6 leaves; involucre densely black lanate, rays white, heads 1 inch in diameter. I suggest the varietal name **melanocephalus** for this form.

Erigeron ursinus, Eaton, Bot. King's Exp. 148 (1871).

On rocky hills and ledges, 7,000-11,000 ft., successively throughout the season.

Table Mountain, June 2, 1894 (No. 144); La Plata Mines, August 23, 1895 (No. 1795).

Filago depressa, Gray, Proc. Am. Acad. xix, 3.

Not having seen an authentic *F. depressa*, I give the above determination with some reservation. In a gravelly hollow near the Little Laramie River, Centennial Valley, August 19, 1895 (No. 1751).

Antennaria alpina, Gærtn. Fr. & Sem. ii, 410 (1791).

Frequent, on dry hillsides.

Union Pass, August 11, 1894 (No. 853); Centennial Valley, June 9, 1895 (No. 1265),

Antennaria Carpathica pulcherrima, Hook. Fl. i, 329 (1834).

Probably throughout the state, in the rich soil of thickets.

Pole Creek, June 9, 1894 (No 110); Union Pass, August 12, 1894 (No. 819).

Antennaria dioica, Gærtn. l. c.

Of this variable species we have our full share of forms. Laramie, Inyan Kara Divide, Wind River and Green River are places from which specimens are at hand (Nos. 762 and 885).

Antennaria dioica congesta. D C. Prodr. vi, 269.

This is of frequent occurrence, sometimes with closely depressed stems, at other times, stems several inches in length. Separable from the species by the compactness of the heads.

Laramie, June 28, 1894 (No. 291). A form with strikingly roseate bracts probably belongs here.

Antennaria racemosa, Hook. Fl. Bor. Am. i, 330 (1834).

Rare, and but a few specimens secured.

Union Pass, August 11, 1894 (No. 812).

Anaphalis margaritacea, Benth. & Hook. Gen. Pl. ii, 303 (1873).

Antennaria margaritacea, (L.) Hook.

In deeply shaded copses at the foot of mountains.

Tetons, August 21, 1894 (No. 959); Laramie Peak, August 8, 1895 (No. 1604).

Anaphalis margaritacea subalpina, Gray, Syn. Fl. 233 (1884).

On a rocky creek bed, Centennial Valley, August 16, 1895 (No. 1669).

Gnaphalium palustre. Nutt. Trans. Am. Phil. Soc. n. ser. vii, 404 (1841).

Not common. Wheatland, August 8, 1891, B. C. Buffum; Atlantic City, September 3, 1894 (No. 1186).

Iva axillaris, Pursh, Fl. Am. Sept. 743 (1814).

A troublesome weed in some localities; frequent on the sandy plains of the Platte.

Fairbanks, July 14, 1894 (No. 476). *Poverty Weed.*

Iva xanthifolia, Nutt. Trans. Am. Phil. Soc. (II) vii, 347 (1841).

Infrequent; Willow Creek, July 20, 1894 (No. 569); Cheyenne, August 11, 1891, B. C. Buffum.

Ambrosia psilostachya, D C. Prodr. v, 526 (1836).

An exceedingly annoying weed, its root-stocks making it almost impossible to destroy it by cultivation.

Wheatland, August 11, 1891, B. C. Buffum; Fairbanks, July 11, 1894 (No. 425); Laramie, September 30, 1894.

Ambrosia trifida, L. Sp. Pl. 987 (1753).

Infrequent in the state as yet.

Ford J. Ranch, on Willow Creek, July 21, 1894 (No. 563).

Franseria discolor, Nutt. Trans. Am. Phil. Soc. (II) vii, 345 (1841). *Gærtneria discolor,* (Nutt.) Kuntze.

One more of our weeds; "the more it is dug up the better it thrives."

University campus, July, 1891. B. C. Buffum; Hartville, July 15, 1894 (No. 550).

Franseria Hookeriana, Nutt. l. c. *Gærtneria acanthicarpa,* (Hook.) Britton.

Frequent on sandy plains.

Inyan Kara Divide, August 30, 1892, B. C. Buffum; Big Wind River, August 5, 1894 (No. 707); Sweetwater River, September 9, 1894 (No. 1190).

Xanthium Canadense, Mill. Gard. Dict. Ed. 8, No. 2 (1768).

Not frequent; Cheyenne, August 9, 1891, B. C. Buffum; Platte River, July 14, 1894 (No. 485).

Gymnolomia multiflora, Benth. & Hook. Rothr. Bot. Wheeler Surv. 160 (1876).

Only from Snake River thus far, August 21, 1894 (No. 1064).

Rudbeckia hirta, L. Sp. Pl. 907 (1753).

Common throughout the state.

Specimens from Cheyenne, Laramie, Big Muddy Creek, and Cummins, (Nos. 600, 1144, 1459).

Rudbeckia laciniata, L. Sp. Pl. 906 (1753).

Common on streams in eastern part of the state.

Cottonwood Canon, August 5, 1895 (No. 1575).

Lepachys columnaris, T. & G. Fl. N. A. ii, 314 (1842).

This and the following variety are common on the plains and hills about the Platte

Uva, July 10, 1894 (No. 386).

Lepachys columnaris pulcherrima, T. & G. l. c.

This form maintains itself pretty uniformly in given areas, so seems entitled to varietal name.

Willow Creek, July 20, 1894 (No. 570).

Balsamorrhiza sagittata, Nutt. Trans. Am. Phil. Soc. vii, 349 (1841),

Occasionally growing in the greatest profusion in dry, stony ravines.

Laramie Hills, by B. C. Buffum, June 24, 1892; June 9, 1894 (No. 213).

Balsamorrhiza macrophylla, Nutt. Trans. Am. Phil. Soc. vii, 350 (1841).

Very rare, but one specimen found.

Union Pass, August 10, 1894 (No. 921).

Wyethia amplexicaulis, Nutt. Trans. Am. Phil. Soc. vii, 349 (1841).

Infrequent; Laramie Hills, June 21, 1891, B. C. Buffum; Union Pass Hills, August 11, 1894 (No. 816).

Helianthus annuus, L. Sp. Pl. ii, 904 (1753).

A common weed in some localities.

Cheyenne, August 11, 1891, B. C. Buffum; Fairbanks, July 12, 1894 (No. 432).

Helianthus giganteus, L. Sp. Pl. 905 (1753).

Near streams and in wet bottoms; not frequent.

Muskrat Creek, July 30, 1894 (No. 684); Laramie, October **6,** 1894 (No. 1169).

Helianthus Nuttallii, T. & G. Fl. N. A. ii, 324 (1842).

Secured only west of the Wind River Mountains.

Gros Ventre River, August 16, 1894 (No. 1083).

Helianthus pumilus, Nutt. Trans. Am. Phil. Soc. vii, 366.

Frequent on dry slopes and hilltops.

Platte River Hills, July 14, 1894 (No. 501); also from Casper.

Helianthus rigidus, Desf. Cat. Hort. Paris. Ed. 3, 184 (1813).

Whalen Canon, July 18, 1894 (No. 528); Laramie Peak, August 6, 1895 (No. 1578).

Helianthella quinquenervis, Gray, Proc. Am. Acad. xix, 10.

In the mountains, in open places near streams.

Bald Mountain, by B. C. Buffum; Union Pass, August 10, **1894** (No. 803); Laramie Peak, August 6, 1895 (No. 1654).

Thelesperma gracile, Gray, Kew. Journ. Bot. i, 252 (1849).

Frequent on the hills near the Platte Riiver.

Near Fort Laramie by B. C. Buffum; Blue Grass Hills, July **8,** 1894 (No. 321).

Bidens frondosa, L. Sp. Pl. 832 (1753).

Frequent in the eastern part of the state.

Wheatland, September 1892; Sheridan Experiment Farm, September 1895, J. F. Lewis.

Bidens cernua, L. Sp. Pl. 832 (1753).

In wet places about Wheatland, September 1892, B. C. **Bufium.**

Madia glomerata, Hook. Fl. ii, 24.

A rare plant; in dry rich loam soil.

Big Wind River, August 2, 1892, B. C. Buffum; Laramie **Peak,** August 8, 1895 (No. 1593).

Chænactis Douglasii, Hook. & Arn. Bot. Beechy. 354 (1840-41).

On abrupt stony clay hills.

Mouth of Bacon Creek, August 15, 1894 (No. 909); **Cummins,** July 25, 1895 (No. 1439).

Chænactis Douglasii alpina, Gray, Syn. Fl. 341 (1884).

On subalpine stony hilltops; easily distinguished from **the** species by its striking rosette of radical leaves and its smaller **size.**

Garfield Peak, July 29, 1894 (No. 653); Cummins, July 26, 1895 (No. 1438).

Hymenopappus filifolius, Hook. Fl. Bor. Am. i, 317 (1833).

Frequent on the dry slopes of the Platte and Laramie River hills at 5,000-7,000 ft.

Sybille Creek, July 7, 1894 (No. 328); Table Mountain, June 29, 1895 (No. 1369).

Hymenopappus ligulæflorus, n. sp.

Perennial from a multicipital caudex, each division bearing one leafy stem, 5-8 inches high, glabrous but for some floccose wool on the crown of caudex; leaves simply pinnate into about five linear divisions, impressed punctate; heads few, corymbosely cymose, about ⅓ inch high; involucral bracts oblong, hirsute-villous on the margins, resinous-atomiferous as are also the corollas, the whole strong scented; rays 6-8, ⅓ inch long; lobes of disk corollas very short and erect; achenes short villous; pappus of thin acuminate paleæ, in this respect allying it more closely to *Hymenothrix*; flowers yellow.

Mr. L. Fernald, assistant in Gray Herbarium, who kindly examined it for me, reports it as a form of *H. filifolius*, but I cannot see why it should be left there.

Collected on the north Laramie Plains, about six miles from Owen, August 5, 1895 (No. 1573).

Bahia chrysanthemoides, Gray, Proc. Am. Acad. xix, 28.

Noted at Laramie Peak only, August 6, 1895 (No. 1634).

Bahia oppositifolia, Nutt. T. & G. Fl. N. A. ii, 376 (1842).

Common on the dry, sandy plains of the Platte; July 1894 (Nos. 332 and 602).

Eriophyllum cæspitosum, (Dougl.) Lindl. Bot. Reg. xiv, 1167 (1828).

Probably confined to the northwestern part of the state.

B. C. Buffum, in 1892 without data; Gros Ventre River, August 18, 1894 (No. 1099).

Eriophyllum cæspitosum leucophyllum, Gray, Proc. Am. Acad. xix, 25.

Very rare, in dry stony ravine.

Warm Spring Creek, Union Pass, August 10, 1894 (No. 801).

Dysodia chrysanthemoides, Lag. Nov. Gen. et Sp. 29 (1816). *D. papposa,* (Vent.) A. S. Hitchc.

Common in the eastern part of the state.

From Wheatland, by B. C. Buffum, August 11, 1891; Platte River, July 14, 1894 (No. 499).

Helenium autumnale, L. Sp. Pl. 886 (1753).

Very frequent on river bottoms.

Popo Agie River, August 1, 1894 (No. 736); lone Ranch, August 10, 1895 (No. 1664).

Helenium Hoopesii, Gray, Proc. Acad. Phil. 65 (1863).

Infrequent; Union Pass, August 11, 1894 (No. 841).

Gaillardia aristata. Pursh, Fl. ii, 573.

Frequent and quite variable especially as to foliage. Probably throughout the state.

Platte River Hills, July 11, 1894 (No. 417); Pole Creek, June 27, 1895 (No. 1326).

Actinella acaulis, Nutt. Gen. ii, 173.

Very frequent indeed in various forms, the earlier individuals scapeless as well as stemless.

Laramie Hills, June 7, 1894 (No. 177); Table Mountain, June 27, 1895 (No. 1300).

Actinella glabra, (Nutt.) n. sp.

If ever a plant deserved specific rank, this one does. Many as are the forms of *A. acaulis,* by necessity, there is no excuse for making this one of them. It is clearly separated from that by the much longer branches of the caudex, which are closely covered with the persistent bases of dead petioles, all of which are completely enveloped in long, densely matted wool, brownish-red, except at the summit, where it becomes continuous with the white persistent wool of the scape and involucre. Leaves longer, glabrous and strongly impressed-punctate; heads large, 1 inch or even more across. Roots enormous, sometimes several feet in length; the multicipital caudex forming raised rounded tufts 6-12 inches across, which very early in the spring become covered with fine yellow heads. *A. acaulis glabra,* Gray. *A. glabra,* Nutt.

Exceedingly abundant in the Laramie Hills, where it is in blossom from April to June (Nos. 36 and 1233).

Actinella grandiflora, T. &. G. Bost. Journ. Nat. Hist. Soc. v, 110.

Rare; probably strictly alpine.

On the naked summits of the Medicine Bow Mountains, August 23, 1895 (No. 1822).

Actinella Richardsonii, Nutt. Trans. Am. Phil. Soc. vii, 379.

Rare; only a few specimens secured.

Centennial Hills, August 19, 1895 (No. 1688).

Actinella scaposa linearis, Nutt. Trans. Am. Phil. Soc. vii, 378.

This is a common species in sandy, grassy valleys in the hills.

Table Mountain, June 2. 1894 (No. 91); June 29, 1895 (No. 1341).

Achillea millefolium, L. Sp. Pl. ii, 899 (1753).

From the summits of our mountains to our lowest valleys.

Sybille Creek, July 8, 1894 (No. 409); Wind River Mountains, August 8, 1894.

Anthemis cotula, L. Sp. Pl. 894 (1753).

Introduced in Laramie and possibly elsewhere but apparently not thriving. It would soon disappear were in not reintroduced.

Laramie, October 1894 (No. 1160).

Tanacetum capitatum, T. & G. Fl. N. A. ii, 415.

Infrequent; Laramie, in the "red hills," June 15, 1894 (No. 226).

Artemisia biennis, Willd. Phytogr. 11 (1794).

Very common in waste ground about the city.

Laramie, September 18, 1894 (No. 1145).

Artemisia cana, Pursh. Fl. ii, 521.

This seems to belong to the western slope, where, in the fertile creek valleys, it is the prevailing species.

Bacon Creek, August 25, 1894 (No. 1042); Lewiston, September 5, 1894 (No. 1183).

Artemisia Canadensis, Michx. Fl. Bor. Am. ii, 129 (1803).

Of frequent occurrence on the Big Wind River; by B. C. Buffum, August 2, 1892; August 5, 1894 (No. 710); Laramie Peak, August 6, 1895 (No. 1660).

Artemisia dracunculoides, Pursh, Fl. Am. Sept. 742 (1814).

Infrequent in the parts of the state collected; Eagle Rock Canon, August 22, 1892, B. C. Buffum.

Artemisia filifolia, Torr. Ann. Lyc. N. Y. ii, 211 (1827).

This fine species is also rare unless it be in the northeastern part of the state.

Inyan Kara Divide, August 30, 1892, B. C. Bcffum.

Artemisia frigida, Willd. Sp. Pl. iii, 1838 (1804).

Perhaps the commonest of our long list of "sages," appearing everywhere on the dry plains and in the hills.

Union Pass, August 10, 1894 (No. 861); University campus, September 16, 1894 (No. 1135); Sheridan Experiment Farm, September 1895.

Artemisia Ludoviciana, Nutt. Gen. ii, 143 (1818).

Quite variable, differing especially as to foliage and compactness of panicle. On creek banks throughout the state.

Laramie, October 6, 1894 (No. 1171); Laramie Peak, August 5, 1895 (No. 1643).

Artemisia Ludoviciana integrifolia, n. var.

Leaves all entire, large, (1-3 inches long), narrowly lanceolate, margins revolute; panicle strict, heads fewer and larger than in the species.

Willow Creek, July 20, 1894 (No. 568).

Artemisia Mexicana, Willd. Spreng. Syst. iii, 490.

Infrequent; Sweetwater Stage Station, September 9, 1894 (No. 1181).

Artemisia Norvegica, Fries, in Liljeb. Fl. (1815).

A handsome plant, infrequent, alpine.

Union Peak, August 12, 1894 (No. 897).

Artemisia scopulorum, Gray, Proc. Acad. Phila. 66 (1863).

Probably in all our alpine regions.

Union Peak, August 13, 1894 (No. 989); La Plata Mines, August 22, 1895 (No. 1779).

Artemisia tridentata, Nutt. Trans. Am. Phil. Soc. (II) vii, 398 (1841).

This is the shrub that is generally designated by the term "sage brush," whereas the term sage is applied indiscriminately to the preceding. It is, perhaps, the most characteristic shrub of the Wyoming plains and valleys. Its presence indicates soil of good quality, reasonably free from alkali. Of very slow growth, but on some creeks reaching the dignity of small trees and furnishing excellent fuel.

Boulder Creek, August 25, 1894 (No. 1111).

Artemisia trifida, Nutt. l. c.

No specimens of this species are at hand but it is known to be in the state.

Noted by Prof. W. C. Knight, on Seminoe Mountains, May 6, 1896, at about 8,000 ft. altitude.

Petasites sagittata, Gray, in Brew. & Wats. Bot. Cal. i, 407 (1876).

Tussilago sagittata, Pursh.

Rare; in a wet, boggy meadow.

Pole Creek, May 25, 1894 (No. 81).

Arnica alpina, Olin. Mon. Arn. Upsala (1799).

Very abundant about Table Mountain, where it was collected June 2, 1894 (No. 148); June 30, 1895 (No. 1383).

Arnica amplexicaulis, Nutt. Trans. Am. Phil. Soc. vii, 408.

Frequent in copses in fertile subalpine valleys.

Teton Mountains, August 21, 1894 (No. 933); Centennial Hills, August 19, 1895 (No. 1702).

Arnica Chamissonis, Less. Linnæa, vi, 317 (1831).

Frequent in the mountains.

Pine Creek, by B, C. Bufum; Union Peak, August 13, 1894 (No. 995); La Plata Mines, August 23. 1895 (No. 1785).

Arnica cordifolia, Hook. Fl. Bor. Am. i, 331 (1833).

Exceedingly abundant; in woods and copses in the mountains from their bases to their summits. Somewhat variable, the radical leaves often reduced and ovate rather than cordate.

Horse Creek June 9, 1894 (No. 215); Union Pass, August 10, 1894 (No. 871); also from the Centennial Valley.

Arnica foliosa, Nutt. Trans. Am. Phil. Soc. vii, 407.

Probably rare; collected only on upper Wind River, August 10, 1894 (No. 766).

Arnica foliosa incana, Gray, Bot. Cal. i, 416 (1876).

Specimens from Pine Creek, by Prof. B. C. Buffum, presumably nearly typical; others less so from Saratoga, July 2, 1893, by J. D. Parker.

Arnica latifolia, Bong. Veg. Sitch. 147.

A beautiful subalpine species, probably in all of our mountains.

Bald Mountain, B. C. Buffum, in August 1892; Union Pass, August 11, 1894 (No. 836); noted in Medicine Bow Mountains.

Arnica longifolia, Eaton, Bot. King Exp. 186.

Decidedly rare; Teton Mountains, August 21, 1894 (No. 957).

Senecio amplectens taraxacoides, Gray, Proc. Acad. Phila. 67 (1863).

Very rare; only a few specimens from the Teton Mountains, August 22, 1894 (No. 987).

Senecio aureus, L. Sp. Pl. ii, 870 (1753).

This and many of its varieties are well represented in our flora. The individual variation is often so great that it is difficult to assign some specimens to any of the numerous varieties already created.

Specimens from Green River, August 26, 1894 (No. 1036), and Wind River, August 10, 1894 (No. 760) I think are nearly typical, as are also some from Beaver Creek and Laramie, by B. C. Buffum.

Senecio aureus borealis, T. & G. Fl. N. A. ii, 442.

On the rocky slopes of the Teton Mountains, August 21, 1894 (No. 979).

Senecio aureus croceus, Gray, Proc. Acad. Phila. 68 (1863)

This is a frequent form in subalpine meadows.

Union Pass, August 10, 1894 (No. 858); La Plata Mines, August 20, 1895 (No. 1753).

Senecio aureus obovatus, T. & G. Fl N. A. ii, 442.

Typical specimens from Big Wind River, August 5, 1894 (No. 704); doubtful ones from La Plata Mines, August 23, 1895 (No. 1769).

Senecio Balsamitæ (?) Muhl. Willd. Sp. Pl. iii, 1998 (1804).

I think there is little doubt of the two sets of specimens before me belonging here; they lack the root leaves upon which the description partly hinges, but seem normal otherwise.

Eagle Rock Canon, August 2, 1892, B. C. Buffum; Cummins, July 30, 1895 (No. 1492).

Senecio canus, Hook. Fl. Bor. Am. i, 333 (1834).

This strongly marked species is of frequent occurrence in the state. Our specimens are large, stoloniferous and slightly decumbent at base.

Union Pass, August 10, 1894 (No. 761); Table Mountain, June 30, 1895 (No. 1364).

Senecio crassulus, Gray, Proc. Am. Acad. xix, 54.

Probably in the subalpine regions of all our mountains.

A large form in Union Pass, August 10, 1894 (No. 809); smaller and more typical, Union Peak, August 13, (No. 1027); La Plata Mines, August 21, 1895 (No. 1770).

Senecio Douglasii, D C. Prodr. vi, 429 (1837).

This is of frequent occurrence, the three main forms being represented: 1. Glabrous, stems branched, leaves broad, with broad, unequal lobes; rays long, narrow (6-10). This is probably the suppressed *Senecio fastigiatus*, Gray. 2. Slightly pubescent-tomentose stems paniculately branched only at summit; leaves pinnately parted into linear lobes, the rays few and inconspicuous. This form is Bentham's *Senecio longilobus*. 3. Glabrous, stems very numerous from a woody base, strict; leaves entire, linear; inflorescence a short cymose panicle; rays long and conspicuous. This is *Senecio Ridellii*, T. & G.

I see no reason why forms so distinct should not be kept separate. 1. From Pole Creek, July 1, 1895 (No. 1389); 2. Sybille Hills, July 8, 1894 (No. 302), and Cummins, July 27, 1895 (No. 1441); 3. Cummins, July 27, 1895 (No. 1440).

Senecio eremophilus, Richards. App. Frankl. Journ. Ed. 2, 31.

Infrequent; Cummins, July 29, 1895 (No. 1491).

Senecio Fendleri, Gray, Pl. Fendl. 108.

A very common form in stony clay hills.

Pole Creek, June 2, 1894 (No. 124); Centennial Valley, June 9, 1895 (No. 1297).

Senecio hydrophilus, Nutt.

Frequent, but never plentiful; in wet and sometimes boggy places.

Bacon Creek, August 15, 1894 (No. 915); Cummins July 28, 1895 (No. 1458).

Senecio integerrimus, Nutt. Gen. ii, 165.

Very frequent in fertile, open valleys in the mountains.

Union Pass, August 14, 1894 (No. 891); Teton Mountains, August 21, 1894 (No. 1002); Table Mountain, June 26, 1895 (No. 1333).

Senecio lugens, Richards. Bot. App. 748 (1823).

Very common and of many forms which probably are worthy of varietal distinction. The following numbers appear early on hillsides and valleys and are probably near the type:

Table Mountain, June 2, 1894 (No. 128); Centennial Valley, June 9, 1895 (No. 1305).

Senecio lugens foliosus, Gray, Bot. Cal. i, 413.

On hillsides, in rich loam soil among undershrubs.

Union Pass, August 13, 1894 (No. 999); Centennial Valley, June 9. 1895 (No. 1246).

Senecio lugens megalocephalus, n. var.

Radical leaves large, irregularly and coarsely dentate; cauline leaves small or wanting; stem branched from near the base into several slender branches 8-12 inches long, each bearing a few (3-5) large heads (5-8 lines high). The whole plant is very tardily glabrate. In thickets on moist hillsides.

Centennial Valley, June 9, 1895 (No. 1252).

Senecio rapifolius, Nutt.

Said to be a very rare plant.

Sweetwater River, September, 1894 (No. 1180); Laramie Peak, August 7, 1895 (No. 1589).

Senecio serra, Hook. Fl. Bor. Am. i, 333 (1834).

Infrequent; near Warm Spring Creek, August 10, 1894 (No. 771).

Senecio serra integriusculus, Gray, Syn. Fl. 387 (1884). *S. Andinus*, Nutt.

A rare plant; in the Union Pass hills, August 10, 1894 (No. 876).

Senecio triangularis, Hook. Fl. Bor. Am. i, 332 (1834).

On wet banks in copses in mountain canons.

Teton Mountains, August 21, 1894 (No. 936); Cummins, July 31, 1895 (No. 1519).

Senecio werneræfolius, Gray, Proc. Am. Acad. xix, 54.

Frequent in the "red hills" (Tertiary) about Laramie, June 15, 1894 (No. 224); Table Mountain, June 29, 1895 (No. 1379).

Tetradymia canescens, D C. Prodr. vi, 440 (1837).

On the dry plains of the Platte; Big Muddy Creek, July 23, 1894 (No. 605).

Tetradymia canescens inermis, Gray.

While not separated from the species by any strong botanical characters, yet readily distinguished by foliage and general habit.

Wallace Creek, July 29, 1894 (No. 656).

Cnicus altissimus filipendulus, Gray, Proc. Am. Acad. xix, 56.

Specimens received from Sheridan Experiment Farm seem to belong to this variety, probably introduced with farm seeds. September, 1895.

Cnicus Americanus, Gray, Proc. Am. Acad. xix, 56.

In the dry foothills near the Laramie River; not frequent.

Cummins, July 29, 1895 (No. 1512)

Cnicus arvensis, Hoffm. Deutch. Fl Ed. 2, I: Part 2, 130 (1804). *Carduus arvensis*, (L.)Robs.

Thus far this, the *Canada Thistle*, has been reported from only one place in the state.

Specimens from Sheridan, September 1895, J. F. Lewis.

Cnicus Drummondii, Gray, Proc. Am. Acad. x, 40. *Carduus pumilus*, Hook.

Very frequent throughout the state.

Laramie, September, 1893: Union Pass, August 14, 1894 (No. 881); Cummins, July 27, 1895 (No. 1469).

Cnicus lanceolatus, Hoffm. *Carduus lanceolatus*, L.

Becoming plentiful in vacant lots and along the irrigation ditches.

Cnicus ochrocentrus, Gray, Proc. Am. Acad. xix, 57 (1883).

In dry, open ground in the hills; frequent.

Laramie Hills, July 7, 1894 (No. 414); Gros Ventre River, August 22, 1894 (No. 1070).

Cnicus undulatus, Gray, Proc. Am. Acad. x, 42 (1874). *Carduus undulatus*, Nutt.

Frequent; Cheyenne, August 11, 1891, B. C. Buffum; Laramie, October 2, 1894 (No. 1156).

Cnicus Virginianus, Pursh, Fl. ii, 506 (1814). *Carduus Virginianus*, L.

Very rare; a few specimens from a dry bank, Cummins, July 30, 1895 (No. 1563).

Crepis acuminata, Nutt. Trans, Am. Phil. Soc. vii, 437.

On dry, sometimes stony ground, in the hills and mountains.

Laramie, July 7, 1894 (No. 356); Union Pass, August 10, 1894 (No. 919).

Crepis elegans, Hook, Fl. i, 297.

A very rare plant; noted but once.

Union Pass, August 12, 1894 (No. 1076).

Crepis glauca, T. & G. Fl. N. A. ii, 488 (1843).

Frequent in wet alkali meadow lands.

Meadow Creek, August 9, 1894 (No. 787); Centennial Valley, August 16, 1895 (No. 1673).

Crepis intermedia, Gray, Syn. Fl. 432 (1884).

Rare; secured by B. C. Buffum on the Wind River, August 2, 1892.

Crepis intermedia gracilis, Gray, Syn. Fl. 432 (1884).

Frequent on dry hillsides in the Laramie range.

Table Mountain, June 30, 1895 (No. 1393).

Crepis runcinata, T. & G. Fl. N. A. ii, 487 (1843).

Infrequent; secured by B. C. Buffum near Big Wind River, August 1, 1892.

Hieracium albiflorum, Hook. Fl. i, 298.

Abundant on a dry hillside among the fallen timber in a burned-over district.

Centennial Hills, August 16, 1895 (No. 1678).

Hieracium Canadense, Michx. Fl. ii, 86 (1803).

Infrequent; Wolf Creek, August 18, 1892, B. C. Buffum.

Hieracium Fendleri, Schultz, Bip. Bonplandia, ix, 173.

As near as I can judge without other material for comparison, these specimens are nearly typical.

Plentiful on the banks of the Little Laramie River, in the Centennial Valley, August 25, 1895 (No. 1857).

Hieracium gracile, Hook. Fl. i, 298.

Very typical specimens from the Medicine Bow Mountains, where in the alpine region it is found in the greatest profusion. August 23, 1895 (No. 1802).

A very diminutive form was secured on the Teton Mountains; radical leaves only 3-6, stems single, bearing one to four heads. Var. **minimum** would be a suitable designation. August 21, 1894 (No. 1060).

Hieracium Scouleri, Hook. Fl. i, 298.

Very abundant on the Gros Ventre Hills, but not observed east of the Wind River Mountains. August 23, 1894 (No. 963).

Troximon aurantiacum, Hook. Fl. i, 300, t. 104.

Infrequent; Pole Creek, June 29, 1895 (No. 1342).

Troximon aurantiacum purpureum, Gray, Proc. Am. Acad. xix, 72.

Found occasionally in the vicinity of Laramie; Pole Creek, June 30, 1895 (No. 1376); Hutton's Grove, August 9, 1891, B. C. Buffum.

Troximon cuspidatum, Pursh, Fl. Am. Sept. 742 (1814). *Nothocalais cuspidata* (Pursh) Greene.

Somewhat variable; only a few of my numerous specimens typical; possibly some of them should be cut out. Frequent but scattering.

Laramie, August 1893; Wallace Creek, July 29, 1894 (No. 673); from several other places and noted in many localities.

Troximon glaucum, Pursh, Fl. 505 (1814). *Agoseris glauca* (Pursh) Greene.

Frequent in the grassy valleys in the hills and mountains.

Eagle Rock Canon, August 22, 1892, B. C. Buffum; Union Pass, August 10, 1894 (No. 870).

Troximon glaucum dasycephalum, T. & G. Syn. Fl. 432 (1884).

Seemingly nearly alpine and occasionally very abundant.

Union Pass, August 10, 1894 (No. 868); La Plata Mines, August 21, 1895 (No. 1765).

Troximon glaucum laciniatum, Gray, Bot. Cal.

This form I have never been able to locate to my satisfaction, but I am unable to place it under any other name. It is of very frequent occurrence among the sage brush in the Laramie Hills; June 2, 1894 (No. 125); Pole Creek, June 29, 1895 (No. 1376).

Taraxacum officinale, Weber, Prim. Fl. Holst. 56 (1780). *T. Taraxacum,* (L.) Karst.

Apparently the *Dandelion* found its ideal home when it reached Laramie. It occupies every foot of ground along the irrigation ditches of our streets and takes complete possession of the lawns where eternal warfare is not waged upon it. In luxuriant growth and blossom from April to November (No. 80).

Taraxacum officinale alpinum, Koch. Fl. Germ. & Helv. 428 (1837).

Of the several forms of native Dandelions this seems to be the most frequent. Abundant in the high, grassy valleys of the Laramie range.

Pole Creek, June 2, 1894 (No. 109); Centennial Valley, August 17, 1895 (No. 1715).

Taraxacum officinale lividum, (?) Koch.

Some specimens collected by B. C. Buffum, 1892, are doubtfully placed here, and some with nearly entire glaucesent leaves are for the present passed over.

Lactuca leucophæa, Gray, Proc. Am. Acad. xix, 73.

Probably very rare in the state.

Centennial Valley, August 16, 1895 (No. 1674).

Laetuca Ludoviciana, D C. Prodr. vii, 141 (1838).

Rare; possibly confined to the eastern part of the state.

Laramie Peak, August 7, 1895 (No. 1596).

Lactuca pulchella, D C. Prodr. vii, 134 (1838).

Very frequent in the fertile soil of valleys.

Blue Grass Creek, July 13, 1894 (No. 445); Laramie, September 16, 1894 (No. 1146).

Sonchus asper, (L.) All. Fl. Ped. i, 222 (1785).

This has found its way into several parts of the state; Lander, August 3, 1894 (No. 872); Evanston, September 1, 1894, sent by Dr. Solier

Lygodesmia grandiflora, T. & G. Fl. ii, 485.

Very rare; some specimens by B. C. Buffum from near Tie Siding, July 18, 1891.

Lygodesmia juncea, Don. Edinb. Phil. Journ. vi, 311 (1829).

A "weedy" plant very common on the Laramie Plains.

University campus, September 26, 1894 (No. 1165). *Skeleton Weed.*

Stephanomeria minor, Nutt. Trans. Am. Phil. Soc. (II) vii, 427 (1841).

Ptiloria tenuifolia, (Torr.) Raf.

Probably not rare, though observed but twice.

Gros Ventre Hills, August 16, 1894 (No. 925); also a small form of it from Laramie Peak, August 24, 1895 (No. 1624).

Stephanomeria runcinata, Nutt. l. c. 428. *Ptiloria pauciflora,* (Torr.) Raf.

Infrequent; on a ridge of disintegrated rock, Garfield Peak, July 27, 1894 (No. 655).

CAMPANULACEÆ.

Campanula Parryi, Gray, Syn. Fl. Suppl. 395.

Rare; probably confined to the high, grassy valleys of the southern part of the state.

Cummins, July 31, 1894 (No. 1495).

Campanula rotundifolia, L. Sp. Pl. 163 (1753).

One of the very commonest plants in all our hills and mountains, at least where a reasonable amount of moisture is to be found.

Cold Springs, July 14, 1894 (No. 448); Union Pass, August 11, 1894 (No. 814); Cummins, August 1, 1895 (No. 1540). *Blue Bell.*

Specularia perfoliata, A. DC. Mon. Camp. 351 (1830). *Legouzia perfoliata,* (L.) Britton.

Not infrequent in the eastern part of the state.

Whalen Canon, July 18, 1894 (No. 514); Laramie Peak, August 8, 1895 (No. 1657).

ERICACEÆ.

Vaccinum cæspitosum, Michx. Fl. Bor. Am. i, 234 (1803).

Very abundant in the Medicine Bow Mountains and producing the small, sweet berries in profusion.

Centennial Hills, August 18, 1895 (No. 1728). *Blueberry.*

Vaccinum Myrtillus, L. Schk. Handb. t. 107.

In openings in the Spruce timber at high elevations; infrequent.

July 1892, by B. C. Buffum; Centennial Hills, June 9, 1895 (No. 1292).

Arctostaphylos Uva-ursi, (L.) Spreng. Syst. ii, 287 (1825).

Throughout the state, both on open and on wooded hillsides.

Laramie Hills, May 18, 1894 (No. 1214). *Kinnikinick.*

Bryanthus empetriformis, Gray, Proc. Am. Acad. vii, 377.

A beautiful alpine species; in small basin-like heath among the Spruce trees.

Union Peak, August 13, 1894 (No. 1006).

Kalmia glauca, Ait. Hort. Kew. ii, 64 t. 8 (1811).

Rare; on the margin of a little lake at 9,000 ft., Teton Mountains, August 21, 1894 (No. 952).

Pyrola chlorantha. Sw. Act. Holm. 1810, t, 5 (1810).

In deep, shaded ravines; Cummins, July 31, 1895 (No. 1505).

Pyrola minor, L. Sp. Pl. 396 (1753).

On the shaded border of a lake immediately at the base of one of the perpetual snow banks of the Medicine Bow Mountains.

La Plata Mines, August 23, 1895 (No. 1825).

Pyrola rotundifolia, L. Sp. Pl. 396 (1753).

Infrequent; Teton Mountains, August 21, 1894 (No. 947).

Pyrola rotundifolia uliginosa, Gray, Man. Ed. 2, 259 (1856). *P. uliginosa,* Torr.

Much more frequent than the species; abundant in cold, shaded, wet places in the mountains.

Centennial Hills, August 19, 1895 (No. 1729).

Pyrola secunda, L. Sp. Pl. 396 (1753).

Very abundant in deep woods, especially of high, rich valleys.

Bald Mountain, August 15, 1892; Union Pass, Augnst 10, 1894 (No. 802); Cummins, July 30, 1895 (No. 1504).

Moneses uniflora, Gray, 273 (1848).

In the densely shaded woods about a mountain lake on the Tetons, August 21, 1894 (No. 945); also by B. C. Buffum in a gulch near Bald Mountain, 1892.

Chimaphila umbellata, Nutt. Gen. i, 274 (1818).

On mountain sides in the woods or in the shade of overhanging cliffs.

Teton Mountains, August 21, 1894 (No. 946); Laramie Peak, August 6, 1895 (No. 1616).

MONOTROPACEÆ.

Pterospora Andromedea, Nutt. Gen. i, 269 (1818).

In the pine woods, frequent but not abundant.

Snake River, August 22, 1894 (No. 985); Centennial Valley, August 17, 1895 (No. 1681).

Monotropa Hypopitys, L. Sp. Pl. 387 (1753). *Hypopitys Hypopitys,* (L.) Small.

Infrequent; Centennial Hills, August 17, 1895 (No. 1708).

PRIMULACEÆ.

Primula farinosa, L. Sp. Pl. 143 (1753).

Very rare; not found by the writer, but three fine specimens received from Mr. Houghton, who collected them on the Little Laramie River, June 8, 1894 (No. 187).

Primula Parryi, Gray, Am. Journ. Sci. II, xxxiv, 257.

A very rare plant; collected by B. C. Buffum in the Wind River Mountains, July 21, 1892.

Androsace filiformis, Retz. Obs. ii, 10.

Very abundant in wet, caved in places on mountain streams.

Pole Creek, June 27, 1895 (No. 1318); La Plata Mines, August 23, 1895 (No. 1848).

Androsace occidentalis, Pursh, Fl. Am. Sept. 137 (1814),

Common on dry creek banks, especially in cattle wallows where other vegetation has been killed.

Horse Creek, June 9, 1894 (No. 194); Centennial Valley, June 8, 1895 (No. 1244)

Androsace septentrionalis, Lam. Ill. t. 98, f. 2.

On moist hillsides at both the higher and the lower altitudes.

Union Pass, August 13, 1894 (No. 1030); Table Mountain, June 27, 1895 (No. 1332).

Androsace septentrionalis subumbellata, n. var.

A diminutive alpine form may receive this name. Plant only ½ to 1 inch high; leaves mostly entire; scapes few and one flowered, or, if umbelliferous only three to five; calyx shorter than the corolla, its lobes noticeably shorter than its tube.

On a grassy hillside near the summit of Union Peak, August 13, 1894 (No. 998).

Dodecatheon Meadia, L. Sp. Pl. 144 (1753).

On the partly shaded banks of small brooklets in the Laramie Hills.

Pole Creek, June 27, 1895 (No. 1329).

Dodecatheon pauciflorum, Greene.

The wet meadows in the Laramie River bottoms, in some places, are so densely covered with this plant that at a distance they suggest immense lakes of purplish-blue water. June 19, 1894 (No. 268); Centennial Valley, June 9, 1895 (No. 1312).

Dodecatheon, sp.

Some very small specimens secured by B. C. Buffum at Bald Mountain, with single flowered scapes, probably belong to the var. *alpina*, Gray, of *D. Meadia.* August 8, 1892.

Steironema ciliatum, Baudo, Ann. Sci. Nat. (II) xx, 346 (1843).

Rich soil in thickets on streams.

Laramie Peak, August 7, 1895 (No. 1582); Bald Mountain, August, 1892.

Glaux maritima, L. Sp. Pl. 148 (1753).

On the low, wet shores of alkali ponds and lakes; abundant.

Laramie, June 16, 1894 (No. 248).

OLEACEÆ.

Fraxinus viridis, Michx. f. Hist. Arb. 3: 115, t. 10 (1813). *F. lanceolata*, Borck.

Rare in the parts of the state collected.

Platte River, July 14, 1894 (No. 480).

APOCYNACEÆ.

Apocynum androsæmifolium, L. Sp. Pl. 213 (1753).

Frequent on grassy slopes in the foothills of the Platte.

Whalen canon, July 19, 1894 (No. 535); Laramie Peak, August 7, 1895 (No. 1632).

Apocynum cannabinum, L. Sp. Pl. 213 (1753).

Rare in the districts collected, but probably frequent in the northeast.

On the banks of the Platte, July 11, 1894 (No. 396); also on the Big Muddy, July 23, 1894 (No. 596).

ASCLEPIADACEÆ.

Acerates viridiflora linearis, Gray, Syn. Fl. 2.

Rare; occasional specimens on the banks of the Platte River.

Fairbanks, July 14, 1894 (No. 489).

Asclepias cryptoceras, Watson, King's Rep. (1871).

This is a rare plant, coming into our range only in the western part.

Snake River, May 29, 1892, by Fred McCoullough.

Asclepias Hallii, Gray, Proc. Am. Acad. viii, 69.

Infrequent; on the banks of a clayey ravine at Wood's Landing, July 31, 1895 (No. 1556).

Asclepias speciosa, Torr. Ann. Lyc. N. Y. ii, 218 (1827).

Frequent in the eastern part of the state.

Lusk, July 21, 1894 (No. 575); McGill's Ranch, on the Laramie River, August 3, 1895 (No. 1573).

Asclepias verticillata pumila, Gray, Proc. Am. Acad. xii, 71 (1876).

Rare; in a sandy canon leading to the Platte; Fairbanks, July 14, 1894 (No. 466).

GENTIANACEÆ.

Gentiana affinis, Griseb. Hook. Fl. Bor. Am. i, 56 (1834).

In wet meadows at 8,000 to 10,000 ft.

Upper Wind River, August 8, 1894 (No. 754); Snake River, August 22, 1894 (No. 960); La Plata Mines, August 22, 1895 (No. 1853).

Gentiana Amarella acuta, Hook. *G. acuta*, Michx.

In meadow lands on the Laramie River and its tributaries; very abundant.

Cummins, July 30, 1895 (No. 1543); Centennial Valley, August 25, 1895 (No. 1852).

Gentiana Amarella stricta, Watson, King's Rep. (1871).

Rare; specimens from Wolf Creek, August, 1892, by B. C. Buffum.

Gentiana calycosa, Griseb. in Hook. Fl. Bor. Am. ii, 68 (1838).

This beautiful alpine species probably in all of our higher mountains.

Tetons, August 21, 1894 (No. 1057); La Plata mines, August 22, 1895 (No. 1767).

Gentiana frigida, Hænke. Jacq. Coll. ii, 13.

As rare as it is odd; on the shore of a small alpine lake, La Plata Mines, August 23, 1895 (No. 1804).

Gentiana humilis, Stev. Act. Mosq. iii, 258).

Frequent on the banks of small creeks in the hills and mountains.

Horse Creek, June 9, 1894 (No. 220); Centennial Valley, June 9, 1895 (No. 1313).

Gentiana Oregana, Engelm. Gray, Syn. Fl. ii, pt. i, 122 (1886).

Infrequent; in a mountain valley, at 8,000 ft.; Cummins, July, 29, 1895 (No. 1527).

Gentiana Parryi, Engelm. Trans. St. Louis Acad. ii, 218, t. 10.

Wet, subalpine valleys.

Cummins, July 29, 1895 (No. 1526); Bald Mountain, August 17, 1892.

Gentiana serrata holopetala, Gray, Bot. Cal. i, 481 (1876).

Under this name I have two quite distinct forms, neither of which is typical, but lacking salient characters enough to separate them. The one is small and simple stemmed, the other freely branched from the base. Both with unusually large showy flowers conspicuously fringed. Remarkably abundant in high, wet valleys.

Union Pass, August 10, 1894 (No. 865); Cummins, July 30, 1895 (No. 1539); Centennial Valley, August 17, 1895 (No. 1725); La Plata, August 21, 1895 (No. 1766).

Gentiana tenella, Rottb. Act. Haffn. x, 436, t. 2.

Rare; Cummins, July 27, 1895 (No. 1518).

Pleurogyne rotata, Griseb. Gent. 309 (1839).

Very rare; on the hummocks in a swampy meadow, Centennial Valley, August 18, 1895 (No. 1701).

Swertia perennis, L. Sp. Pl. i, 226 (1753).

In subalpine meadow swamps; frequent.

Union Pass, August 13, 1894 (No. 988); Centennial Hills, August 20, 1895 (No. 1742),

Frasera speciosa, Dougl. Hook. Fl. Bor. Am. ii, 66 (1838).

By reason of its size, a conspicuous and characteristic object both on the timbered and denuded mountain slopes.

Wind River Mountains, August 12, 1894 (No. 935); Laramie Peak, August 6, 1895 (No. 1609).

POLEMONIACEÆ.

Phlox bryoides, Nutt. Journ. Acad. Phila. II. i, 153 (1848).

This is very abundant on rather naked limestone ridges where they crop out on the Laramie Plains and in the foothills. May 25, 1894 (No. 67); June 7, 1895 (No. 1280).

Phlox cæspitosa, Nutt. Journ. Acad. Phila. vii, 41 (1834).

One of the earliest flowers on the plains; very abundant; pink flowered forms are common.

Laramie, May 12, 1894 (No. 8), and at various other times.

Phlox Douglasii, Hook. Fl. Bor. Am. 2: 73, t. 158 (1834).

On the sides of dry, sandy ravines and ridges; infrequent.

Uva, July 10, 1894 (No. 397); also from Beaver Divide, July, 1891.

Phlox longifolia, Nutt. Journ. Acad. Phila. vii, 41 (1834).

Leaves mostly less than an inch in length, otherwise the plant seems typical; very abundant in the Laramie Hills; June 7, 1894 (No. 182), and at several other times.

Phlox longifolia brevifolia, Gray.

Specimens perfectly in accord with description in Syn. Fl. were obtained at La Plata Mines, August 24, 1894 (No. 1827).

Phlox nana, Nutt. Pl. Gamb. 153.

If this determination is right, which it is if the descriptions go for anything, this extends the range of this plant quite a little.

Collected on Snake River, May 29, 1892, by Fred McCoullough.

Gilia aggregata, Spreng. Syst. i, 626 (1825).

Widely distributed, but never in any great abundance; Beaver Creek, July 17, 1892; Bell Springs, July 4, 1891; Snake River, August 22, 1894 (No. 961).

Gilia aggregata attenuata, Gray, Syn. Fl. II, i, 145 (1886).

On an abrupt, stony, gravelly bank of the Laramie River. Cummins, July 29, 1895 (No. 1522).

Gilia Breweri, Gray, Proc. Am. Acad. viii, 266.

Infrequent; possibly confined to the Pacific slope.

Gros Ventre River, August 18, 1894 (No. 1094).

Gilia gracilis, Hook. Bot. Mag. t, 2924 (1829).

Very abundant on the rich sandy loam of the small valleys of the Laramie Hills and in similar locations throughout the state.

Pole Creek, June 2, 1894 (No. 107); Inyan Kara Divide, August 30, 1892.

Gilia inconspicua, Sweet, Hort. Brit. 286 (1826).

Thus far only from the Big Wind River, August 3, 1892, by B. C. Buffum; August 5, 1894 (No. 709).

Gilia inconspicua sinuata, Gray, Proc. Am. Acad. viii, 278.

This extends the range of this plant northward somewhat; in the sandy bed of a dry creek; Muskrat July 30, 1894 (No. 683).

Gilia linearis, Gray, Proc. Am. Acad. xvii, 223 (1882). *Collomia linearis*, Nutt.

This is by far the most frequent of our Gilias, common in the rich loam along streams everywhere.

Pole Creek, June 2, 1894 (No. 108); Sybille Creek, July 8, 1894 (No. 401).

Gilia minima, Gray, Proc. Am. Acad. viii, 269 (1880). *Navarretia minima*, Nutt.

Not found on the Atlantic slope.

Silver Creek, August 26, 1894 (No. 1129).

Gilia nudicaulis, Gray, Proc. Am. Acad. viii, 266 (1870).

The type locality is in the western part of this state, and the plant is probably common throughout the state, but so small and inconspicuous as usually to be passed over.

Horse Creek, June 9, 1894 (No. 193).

Gilia Nuttallii, Gray, Proc. Am. Acad. viii, 267 (1870).

An undoubted specimen of this species without data, by B. C. Buffum, in 1892. Probably near Bald Mountain, August, 1892.

Gilia spicata, Nutt. Journ. Acad. Phil. (II) i, 156 (1848).

Frequent about the sand dunes in the foothills.

Pass Creek, June 20, 1892; Laramie Hills, June 7, 1894 (No. 175). My number 259 approaches *G. spicata capitata*, Gray, pretty closely, but I do not think it typical.

Polemonium confertum, Gray, Proc. Acad. Phila. 1863, 63 (1863),

A beautiful alpine plant on grassy or rocky slopes.

Union Peak, August 13, 1894 (No. 991); La Plata Mines, August 22, 1895 (No. 1823).

Polemonium confertum mellitum, Gray, l. c.

In crevices and on ledges on the higher rocky summits of the Laramie Mountains.

Richardson's Peak, June 9, 1894 (No. 208); Laramie Peak, August 7, 1895 (No. 1625).

Polemonium humile pulchellum, Gray, Syn. Fl. II. i, 150 (1886).

What seems to belong here was secured by B. C. Buffum in 1892; no other data.

Polemonium occidentale, Greene. Pittonia ii, 75 (1890).

Name communicated by Prof. Greene. Rare; in spring bog on Muddy Creek, August 25, 1894 (No. 1104).

HYDROPHYLLACEÆ.

Hydrophyllum occidentale, Gray, Proc. Am. Acad. x, 314.

This, I am sorry to say, I have distributed as *H. Virginicum,*—a piece of carelessness, for the specimens plainly enough belong here.

Very abundant in the copses on our streams.

Pole Creek, June 2, 1894 (No. 89); Table Mountain, June 29, 1895 (No. 1408).

Ellisia Nyctelea, L. Sp. Pl. Ed. 2, 1662 (1763). *Macrocalyx Nyctelea,* Kuntze.

On dry loam soil on creek banks; observed only on the east slopes of the Laramie range.

Table Mountain, June 27, 1895 (No. 1350).

Phacelia circinata, Jacq. Eclog. 135 t. 91.

Of the synonomy and citations applicable to my specimens, I am in doubt, but all answer to the above in Syn. Fl. II. i, 159.

Inyan Kara Divide, August 30, 1892; Union Peak, August 14, 1894 (No. 1082); Pole Creek, June 26, 1895 (No. 1323).

Phacelia Franklinii, Gray, Man. Ed. 2, 329 (1856).

This gives one more locality for the range of this plant.

Bacon Creek, August 15, 1894 (No. 914).

Phacelia glandulosa, Nutt. Fl. Gambl. 160.

Infrequent and scattering; Pole Creek, June 30, 1895 (No. 1361); also noted at Cummins.

Phacelia Menziesii, Torr. Watson, King Rep. 252.

These handsome specimens were sent to us from Snake River, May 29, 1892, Fred McCoullough.

Phacelia sericea, Gray, Am. Journ. Sci. ser. 2, (1862) xxxiv, 254.

Very common in moist, partly shaded ground in the hills and along streams.

Pole Creek, June, 2, 1894 (No. 102); a white flowered form from the Centennial Valley, June 9, 1895 (No. 1283).

Phacelia sp.

A small annual having affinities with both *P. circinata*, and *P. Franklinii*, must for the present be passed over.

Sybille, July 8, 1894 (No. 318).

BORAGINACEÆ.

Coldenia Nuttallii, Hook. Kew. Journ. Bot. iii, 296 (1851).

In a sandy canon or valley leading to the Big Wind River, August 6, 1894 (No. 719); observed in no other locality.

Echinospermum floribundum, Lehm in. Hook. Fl. 2: 84, t. 164 (1834). *Lapula floribunda*, Greene.

Growing almost at the water's edge on some of the streams in the eastern part of the state.

Sybille Creek, July 7, 1894 (No. 348); Pole Creek, June 29, 1895 (No. 1367).

Echinospermum Lapula, Lehm. Asperif. 121 (1818). *Lapula Lapula*, (L.) Karst.

This weed seems to have found its way into waste places about town.

Laramie, June 17, 1891; also at Uva, July 10, 1894 (No. 424).

Echinospermum Redowskii occidentale, Watson, King's Exp. 246 (1871). *Lapula Texana*, (Scheele) Britton.

Common everywhere; Laramie, June 28, 1894 (No. 294); Blue Grass Hills, July 8, 1894 (No. 305).

Echinospermum Redowskii cupulatum, Gray, in Brew. & Wats. Bot. Cal. i, 530 (1876).

This, I note, has been reduced to the same as the preceding, but to say the least there is a marked difference between the nutlets.

By B. C. Buffum, in the northeastern part of the state, August 19, 1892.

Allocarya Nelsonii, Greene, Erythea iii, 48 (1895).

The original description is as follows: "Annual, diffuse, the stoutish and somewhat succulent branches strigose-pubescent, six inches long, rather densely racemose throughout and with a short bract subtending each pedicel; nutlets ¾ line long, ovate-lanceolate, carinate ventrally almost down to the nearly basal rounded or obscurely trigonous scar, the back with rather few and sharp transverse ridges beset with tufts of uncinate-tipped bristles, the intervals with low, muriculate-roughened tuberculations."

Only one small patch of these plants observed; they had taken possession of a few depressions, possibly old buffalo wallows, on bottom land near Silver Creek, August 26, 1894 (No. 1198).

Allocarya scopulorum, Greene, Pitt. i, 16 (1887).

Rather infrequent; Upper Wind River, August 10, 1894 (No. 768); Centennial Valley, August 25, 1895 (No. 1850).

Krynitzkia Californica subglochidiata, Gray, Bot. Cal. i, 526.

Common on dry loam soil near streams.

Cooper Creek, June 19, 1892; Table Mountain June 28, 1895 (No. 1311).

Krynitzkia crassisepala, Gray, Proc. Am. Acad. xx, 268 (1885). *Cryptanthe crassisepala,* (T. & G.) Greene.

Frequent on sandy plains.

Laramie, August 8, 1891; Blue Grass Creek, July 8, 1894 (No. (304).

Krynitzkia Fendleri, Gray, l. c. *Cryptanthe Fendleri,* (Gray) Greene.

Infrequent; Cummins, July 25, 1895 (No. 1523).

Krynitzkia fulvocanescens, Gray, Proc. Am. Acad. xx, 280 (1885). *Oreocarya fulvocanescens,* (Gray) Greene.

Fine specimens of this were secured by Prof. Buffum, at Cooper Creek, June 18, 1892.

Krynitzkia glomerata, Gray, Proc. Am. Acad. xx, 279 (1885). *Oreocarya glomerata,* (Gray) Greene.

This is perhaps our commonest Krynitzkia; frequent on dry hillsides, railroad embankments and on the plains.

Laramie, July 8, 1894 (No. 418); Table mountain, June 30, 1895 (No. 1362); a very large, coarse form from Uva, July 10, 1894 (No. 388).

Krynitzkia glomeriflora, Greene.

Frequent in dry, rich loam soil along streams.

Pole Creek, near Table Mountain, June 2, 1894 (No. 152); Centennial Valley, June 9, 1895 (No. 1335).

Krynitzkia Jamesii, Gray, Proc Am. Acad. xx, 277. *Oreocarya suffruticosa,* Greene.

Infrequent; in canons near the Platte River, July 14, 1894 (No. 477).

Krynitzkia Pattersoni, Gray, Proc. Am. Acad. xx, 278.

Rare; in the Laramie Hills, July 7, 1894 (No. 412).

Krynitzkia sericea, Gray, Proc. Am. Acad. xx, 277. *Oreocarya sericea,* Greene.

Frequent on rocky slopes in the Laramie Hills; June 16, 1894 (No. 255); Uva, July 10, 1894 (No. 389).

Krynitzkia virgata, Proc. Am. Acad. xx, 279.

Frequent on sandy ridges in the foothills.

Telephone canon, June 15, 1894 (No. 231); Centennial Valley, June 9, 1895 (No. 1267).

Krynitzkia Watsoni (?) Gray, Proc. Am. Acad. xx, 270.

These are somewhat doubtfully placed here; collected on wet, shaded rocky ledges in the Centennial Hills, August 17, 1895 (No. 1684).

Mertensia alpina, Don. Syst. iv, 320.

Strictly alpine from a climatic point of view, but hardly so from that of altitude; very early in the Laramie Hills while freezing nights are still the rule; often in blossom by April 20. (Nos. 33 and 1222).

Mertensia lanceolata, DC. Prodr. x, 88 (1846).

Very variable as to size and general appearance, but floral characters and the light-green glaucus color constant. It is abundant and frequent in our foothills in two forms: a small form from large, coarse rootstocks, very early, radical leaves few, stem leaves nearly uniform, panicle close and leafy; a much larger form later in the season, usually in copses, stem leaves gradually reduced in size, panicle long and open. 1, Laramie Hills, May 16, 1894 (No. 34); 2, Pole Creek, June 28, 1895 (No. 1234).

Mertensia lanceolata viridis, n. var.

Root stocks slender, creeping in the crevices among the rocks; radical leaves numerous, long and slender petioled, from oblong to elliptical; cauline leaves oblong, gradually reduced in size; stems few and slender, 5-8 inches high, bearing an open panicle; floral characters those of the species, except that the corolla tube is wider and shorter. *Mertensia lanceolata,* DC.

This plant is alpine in habitat and may be known by the bright green color of its leaves, which are scarcely scabro-puberulent under a lens.

On rocky ledges near the summit of Laramie Peak, August 7, 1895 (No. 1608).

Mertensia sibirica, Don. Syst. iv, 320.

Quite a large series of specimens from many localities and different altitudes, and of very different general appearance, have all been reduced to this. Environment produces greater differences than is usually conceded. Wet places, along streams and in the mountains; Sybille, July 8, 1894 (No. 408); Garfield Peak, July 29, 1894 (No. 689); Union Pass, August 13, 1894 (No. 1031) and other localities.

Myosotis sylvatica alpestris, Koch.

This beautiful little plant is found in abundance in the alpine regions of our northern mountains. Little Bald Mountain, August 15, 1892 B. C. Buffum; Union Pass, August 11, 1894 (No. 838).

Onosmondium molle, Michx. Fl. Bor. Am. I: 133, t. 15 (1803).

Rare and probably confined to the eastern part of the state. Orin Junction, August 1892; Platte River, July 14, 1894 (No. 506).

Lithospermum angustifolium, Michx. Fl. Bor. Am. i, 130 (1803).

Very common on the plains and in the mountain valleys. University Campus, June 4, 1894 (No. 174); in its fruiting form July 23, 1895 (No. 1428).

Lithospermum pilosum, Nutt. Journ Acad. Phil. vii, 43 (1834).

Much less frequent than the preceding; Middle Pass, June 20, 1892; Gros Ventre River, August 18, 1894 (No. 1090).

CONVOLVULACEÆ.

Ipomea leptophylla, Torr. in Frem. Rep. 95 (1845).

Abundant in the eastern part of the state on the Platte and in the adjacent foothills

Fort Laramie, September 3, 1892; Fairbanks, July 14, 1894 (No. 491).

Convolvulus sepium, L. Sp. Pl. 153 (1753).

Collected by B. C. Buffum, August 1, 1891, probably at Cheyenne. Rare in the state.

Evolvulus argenteus, Pursh Fl. Am. Sept. 187 (1814). *E. Nuttallianus*, R. & S.

Infrequent; dry plains near Uva, July 10, 1894 (No. 398); also at Sheridan, September, 1895.

Cuscuta decora, Engelm. Trans. St. Louis Acad. i, 501 (1859). *C. indecora,* Choisy.

Parasitic on *Alfalfa,* Sheridan Experiment Farm, August 19, 1892.

Cuscuta epilinum, Weihe. Archiv. Apoth. viii. 54 (1824).

On *Alfalfa,* Laramie Experiment Farm, July, 1894 (No. 1210).

SOLANACEÆ.

Solanum rostratum, Dunal. Sol. 234, t. 24 (1813).

Probably abundant on the eastern border.

Fort Laramie, September 5, 1892; Whalen Canon, July 18, 1894 (No. 527). Not yet reported as a bad weed in any locality.

Solanum triflorum, Nutt. Gen. i, 128 (1818).

Particularly annoying as a weed in garden and "truck" patches; small plants, such as *Carrots* and *Parsnips,* must be "weeded" by hand or this weed will completely smother them.

Experiment Farm, September 15, 1894.

Physalis lanceolata, Michx. Fl. Bor. Am. i, 149 (1803).

This genus seems to be confined to the lower altitudes of the north and east; rather plentiful on the Platte and adjoining foothills.

A large form of this species from Blue Grass Hills, August 8, 1894 (No. 365); also a small and more pubescent form from the same place (No. 295).

Physalis lanceolata lævigata, Gray, Proc. Am. Acad. x, 62.

Infrequent; in a canon near the Platte at Fairbanks, July 14, 1894 (No. 478).

SCROPHULARIACEÆ.

Scrophularia Marylandica, L. Sp. Pl. 619 (1753).

Our specimens are far from typical; the thyrsus very narrow, the separate cymes simple; leaves large and truncate at base.

Sybille, July 8, 1894 (No. 317); Pole Creek, June 30, 1895 (No. 1410). Specimens from Garfield Peak, July 29, 1894 (No. 690) have large deltoid-cordate leaves even to the summit of the stem; infloresence only a simple cyme.

Pentstemon acuminatus, Dougl. Lindl. Bot. Reg. t. 1285 (1829).

Abundant in the Laramie range in the foothills, on stony slopes.

Laramie Hills, June 7, 1894 (No. 180); Table Mountain, June 28, 1895 (No. 1325).

Pentstemon cæruleus, Nutt. Gen. ii, 52 (1818).

Frequent on the Laramie Plains, especially on sandy ridges bordering on the Laramie River; June 7, 1894 (No. 179); June 18, 1895 (No. 1308).

Pentstemon cæspitosus, Nutt. Gray, Proc. Am. Acad. vi, 66.

A few good specimens of this rather rare plant from Wheatland, June 11, 1892, by B. C. Buffum.

Pentstemon confertus cæruleo-purpureus, Gray, Proc. Am. Acad. vi. 72.

Frequent on subalpine grassy slopes, and much reduced specimens from alpine locations.

Saratoga July 17, 1892; Union Pass, August 11, 1894 (No. 833); Union Peak, August 13, 1894 (No. 1017).

Pentstemon cristatus, Nutt. Gen. ii, 52 (1818).

Common in sandy ravines in the foothills of the Laramie range and probably elsewhere.

Telephone Canon, June 15, 1894 (No. 235); Pole Creek, June 28, 1895 (No. 1346).

Pentstemon glaber, Pursh, Fl. Am. Sept. 738 (1814).

Infrequent and usually only scattering plants.

Sybille, July 8, 1894 (No. 327); Cottonwood Canon, August 4, 1895 (No. 1566).

Pentstemon glaber Utahensis, Watson, Bot. King Surv. 217 (1871).

Slightly variant, but I believe true specimens of this were obtained in three localities: Gros Ventre River, August 18, 1894 (No. 1093); Cummins, July 30, 1895 (No. 1541); Cottonwood Canon, August 4, 1895 (No. 1579).

Pentstemon glaucus, Graham, Edinb. Phil. Journ. 1829, 348.

Herbarium specimens fail to do justice to this singularly beautiful plant, as shape and color are both largely lost. It occurs in the alpine region of all our ranges.

Tetons, August 21, 1894 (No. 1001); Laramie Peak, August 7, 1895 (No. 1619); La Plata Mines, August 22, 1895 (No. 1792).

Pentstemon humilis, Nutt.

Exceedingly abundant in the Laramie range at the foot of rocky ledges and in stony ravines.

Pole Creek, June 2, 1894 (No. 131); Table Mountain, June 27, 1895 (No. 1322).

Pentstemon laricifolius, Hook. & Arn. Bot. Beechy. 376.

Abundant on stony ridges on the Laramie Plains and their foothills. July 7, 1894 (No. 419); July 27, 1895 (No. 1442).

Pentstemon secundiflorus, Benth. DC. Prodr. x, 324.

Infrequent; specimens by Mr. Hartley from near Sherman, July 9, 1891.

Pentstemon strictus, Benth. DC. Prodr. x, 324.

In stony ravines in the hills; Sybille, July 8, 1894 (No. 402); Cummins, July 28, 1895 (No. 1472).

Collinsia parviflora, Lindl. Bot. Reg. t. 1082 (1827).

Very abundant in sandy loam soil on creek banks.

Pole Creek, June 2, 1894 (No. 46); Centennial Valley, July 17, 1895 (No. 1685).

Mimulus alsinoides, Benth. DC. Prodr. x, 351.

Centennial Hills, August 17, 1895 (No. 1683).

Mimulus floribundus, Lindl. Bot. Reg. xiv, t. 1125 (1828).

Infrequent: good, but diminutive; from a wet ravine near Cummins, July 28, 1895 (No. 1515).

Mimulus glabratus Jamesii, Gray, Syn. Fl. Suppl. 447.

Infrequent; Whalen Canon, July 19, 1894 (No. 543).

Mimulus Langsdorfii Tilingi, Greene, Journ. Bot. for Jan., 1895.

Our commonest Mimulus; springy places in the hills and mountains.

Garfield Peak, July 29, 1894 (No. 688); Centennial Valley, August 16, 1895 (No. 1670).

Mimulus Lewisii, Pursh, Fl. ii, 427 (1814).

On stony, wet ground near creeks; infrequent,

Teton Mountains, August 21, 1894 (No. 942); Centennial Valley, August 16, 1895 (No. 1672).

Mimulus rubellus, Gray, Bot. Mex. Bound. 116.

Rare, or at least rarely observed; our plants small and inconspicuous.

On a naked, gravelly hillside, Centennial, June 9, 1895 (No. 1287).

Synthyris plantaginea, Benth. DC. Prodr. x, 455 (1846).

Some specimens from the Teton Mountains are doubtfully placed here. August 21, 1894 (No. 986).

Synthyris rubra, Benth. l. c. *Wulfenia rubra,* (Hook.) Greene.

Of very frequent occurrence in sage brush valleys; variable as to foliage.

Telephone Canon, May 12, 1894 (No. 29); Laramie Hills, June 5, 1895, (No. 1242).

Veronica alpina, L. Sp. Pl. 11 (1753).

Frequent in subalpine stations; wet, grassy slopes.

Bald Mountain, August 15, 1892; Union Pass, August 11, 1894 (No. 831); Centennial Hills, August 19, 1895 (No. 1740).

Veronica Americana, Schwein. Benth. in DC. Prodr. x, 468 (1846).

In all streams and springs.

Sybille Creek, July 8, 1894 (No. 403); noted in many other localities.

Veronica peregrina, L. Sp. Pl. 14 (1753).

In boggy places; Lander, August 3, 1894 (No. 698); Centennial Valley, August 25, 1895 (No. 1854).

Veronica serpyllifolia, L. Sp. Pl. 12 (1753).

On the grassy banks of our little mountain brooks; frequent.

Horse Creek, June 9, 1894 (No. 192).

Castilleia flava, Watson, Bot. King Surv. 230 (1871).

Of rather frequent occurrence at 7,000-8,000 ft. in the hills.

Laramie Hills, July 7, 1894 (No. 352); Table Mountain, June 27, 1895 (No. 1338).

Castilleia linariæfolia, Benth. DC. Prodr. x, 520.

Hardly subalpine; frequent on sandy, grassy slopes.

Laramie Hills, July 7, 1894 (No. 352); Laramie Peak, August 6, 1895 (No. 1570).

Castilleia miniata, Dougl. Hook. Fl. ii, 106.

I have placed here a number of specimens, some of which rather doubtfully. Most of them were secured on wet stream banks and I think the following numbers, at least, are right. Lander, August 4, 1894 (No. 742); Union Pass, August 11,1894 (No. 835).

Castilleia minor, Gray, Bot. Cal. i, 573 (1876).

Rare; observed but once. Fort Washakie, August 5, 1894 (No. 744).

Castilleia pallida, Kunth. Syn. Pl. Æquin. ii, 100.

On the shaded banks of mountain streams, at 8,000 ft. and upward.

Cummins, July 28, 1895 (No. 1461); observed at a number of other localities.

Castilleia pallida occidentalis, Gray, Bot. Cal. i, 573 (1876).

Some specimens from Union Peak I am unable to place elsewhere; August 13, 1894 (No. 1011).

Castilleia pallida septentrionalis, Gray, l. c.

Undoubted specimens of this were observed in a number of alpine and subalpine stations. This prefers the wet banks of wooded streams or the shores of alpine lakes.

Centennial Hills, August 18, 1895 (No. 1726); La Plata Mines, August 23, 1895 (No. 1808).

Castilleia parviflora, Bong. Veg. Sitch. 158 (1831).

Most frequent and earliest; in sandy loam soil among the sage brush.

Pole Creek, June 2, 1894 (No. 120); Centennial Valley, June 9, 1895 (No. 1291).

Orthocarpus luteus, Nutt. Gen. ii, 56 (1818).

Frequent in wet, sandy soil, especially along streams.

Whalen Canon, July 16, 1894 (No. 534); Lander, August 3, 1894 (No. 741); Cummins, July 30, 1895 (No. 1537).

Orthocarpus pallescens, Gray, Am. Journ. Sci. ser. 2, xxxiv, 339.

From type locality, probably not far from the place where Parry collected it.

Gros Ventre River, August 15, 1894 (No. 900).

Orthocarpus pilosus, Watson, Bot. King Surv. 231 (1871).

This rare plant, determined for me by Dr. Rose, was collected by B. C. Buffum, on Three Mile Creek, June 20, 1892.

Cordylanthus ramosus, Nutt. Gen. ii, 57 (?).

Very abundant on the alkali-clay hills adjacent to the Wind River; at Dubois, August 10, 1894 (No. 711).

Pedicularis bracteosa, Benth. Hook. Fl. ii, 110 (1838).

Probably confined to our northwest areas.

Union Pass, August 11, 1894 (No. 834).

Pedicularis crenulata, Benth. DC . Prodr. x, 568.

Abundant; growing in clumps in high meadow lands.

Laramie, June 19, 1892; Cummins, July 30, 1895 (No. 1528).

Pedicularis Grœnlandica, Retz. Fl. Scand. Ed. 2, 145 (1795).

Frequent and abundant on subalpine mountain streams.

Warm Spring Creek, August 10, 1894 (No. 806); Centennial Hills, August 19, 1895 (No. 1739).

Pedicularis Parryi, Am. Journ. Sci. ser. 2, xxxiii, 250.

Probably rare; a few specimens only, from Union Peak, August 13, 1894 (No. 1033).

Pedicularis procera, Gray, Am. Journ. Sci. ser. 2, xxxiv, 251.

Rare; in a wooded canon leading to the Laramie River, at Cummins, July 30, 1895 (No, 1550).

Pedicularis racemosa, Dougl. Hook. Fl. ii, 108 (1838).

This comes as near as any to marking a zonal belt; encountered at about 9,000 ft. in all our mountain ranges visited, and found up to timber line.

Bald Mountain, August 17, 1892; Union Pass, August 11, 1894 (No. 830); noted at Laramie Peak and in the Medicine Bow Mountains.

OROBANCHACEÆ.

Aphyllon fasciculatum, Gray, Syn. Fl. 2; Part 1, 312 (1878). *Thalesia fasciculata*, Britton.

Frequent and occasionally abundant.

Pine Creek, July 18, 1892; Pole Creek, July 1, 1895 (No. 1360), hosts,—*Artemisia frigida* and *A. Canadensis.*

Aphyllon uniflorum, T. & G. Gray, Man. 290 (1848).

Rare; Gros Ventre River, August 22, 1894 (No. 1071), host not noted.

VERBENACEÆ.

Lippia cuneifolia, Steud. Torr., in Marcy's Rep. 293, t. 17 (1853).

Laramie River bottom lands near Uva; not observed elsewhere. July 10, 1894 (No. 387).

Verbena bracteosa, Michx. Fl. Bor. Am. ii, 13 (1803).

This is a weedy plant, thriving equally well in cultivated and uncultivated grounds.

Blue Grass Hills, July 8, 1894 (No. 320); Laramie Peak, August 8, 1895 (No. 1652).

Verbena stricta, Vent. Hort. Cels, t. 53 (1800).

Probably frequent in the lower altitudes of the northeast; not observed except in the Platte Valley, near Fairbanks, July 14, 1894 (No. 505). A form with several large spikes was obtained in Whalen Canon, July 18, 1894 (No. 538).

LABIATÆ.

Mentha Canadensis, L. Sp. Pl. 576 (1753).

Frequent on all water courses and about springs.

Whalen Canon, July 18, 1894 (No. 546); specimens from a large number of other localities.

Lycopus lucidus, Turcz. Benth. in DC. Prodr. xii, 178 (1848).

Infrequent; Popo Agie River, August 2, 1894 (No. 735).

Lycopus sinuatus, Ell. Bot. S. C. and Ga. i, 126 (1816).

Wet grounds about springs and ponds; frequent.

Laramie, July, 1891; Whalen Canon, July 19, 1894 (No. 542).

Hedeoma Drummondii, Benth. Lab. Gen. and Sp. 368 (1834).

Occasional in dry loam soil.

Whalen Canon, July 19, 1894 (No. 548).

Hedeoma Reverchoni, Gray, Syn. Fl. 363.

Rare; its collection in this state extends the range of this plant northward very much; good specimens from Pole Creek, June 30, 1895 (No. 1374).

Salvia lanceolata, Willd. Enum. 37 (1809).

Only occasionally on rather dry hillsides and plains.

Blue Grass Hills, July 9, 1894 (No. 374); Centennial Valley, August 20, 1895 (No. 1395).

Monarda fistulosa, L. S. Pl. 22 (1753).

Probably confined to the eastern portion of the state; thus far noted only in the region east of Laramie Peak.

Fairbanks, July 14, 1894 (No. 508); Cottonwood Canon, August 4, 1895 (No. 1577).

Lophanthus urticifolius, Benth. Bot. Reg. xv, sub. t. 1282 (1829).

Vleckia urticifolia, (Benth.) Holzinger.

Very rare; possibly only in the northwest.

Snake River, August 22, 1894 (No. 984)

Dracocephalum parviflorum, Nutt. Gen. ii, 35 (1818).

Principally in abandoned fields.

Sybille Creek, July 8, 1894 (No. 326); Laramie Peak, August 8, 1895 (No. 1648).

Scutellaria galericulata, L. Sp. Pl. ii, 599 (1753).

Not infrequent in wet places.

Fairbanks, July 13, 1894 (No. 470); Centennial Valley, August 20, 1895 (No. 1760).

Scutellaria resinosa, Torr. Ann. Lyc. N. Y. ii, 232 (1827).

On abrupt banks along streams, but in comparatively dry ground.

Pole Creek, June 2, 1894 (No. 94); June 29, 1895 (No. 1365).

Brunella vulgaris, L. Sp. Pl. 600 (1753).

Very infrequent in the parts of the state collected

Specimens from Wolf Creek, August 18, 1892, B. C. Buffum.

Physostegia parviflora, Nutt. Benth. in DC. Prodr. 12, 434 (1848).

On the borders of lakes and ponds, growing even in the edge of the water.

Bull Lake, August 8, 1894 (No. 732); Laramie River, near Ione Ranch, August 10, 1895 (No. 1666).

Stachys palustris, L. Sp. Pl. 580 (1753).

Frequent on sandy creek banks which are covered with undershrubs and weedy plants.

Wind River, August 8, 1894 (No. 857); Cummins, July 28, 1895 (No. 1484); noted in many other places.

PLANTAGINACEÆ.

Plantago eriopoda, Torr. Ann. Lyc. N. Y. ii, 237 (1827).

Common on wet alkali flats about Laramie and in similiar locations elsewhere; June 1, 1894 (No. 42). *Plantain.*

Plantago lanceolata, L. Sp. Pl. 113 (1753).

A recently introduced weed on the Lander Experiment Farm; September, 1895, by J. S. Meyer.

Plantago major, L. Sp. Pl. 112 (1753).

Received from Sheridan as one of the weeds upon the Experiment Farm, September, 1895, by J. F. Lewis.

Some specimens from Wolf Creek, apparently native there, collected August 8, 1892, by B. C. Buffum, are doubtfully placed here. Spike very slender and leaves almost acute.

Plantago Patagonica gnaphalioides, Gray, Man. Ed. 2, 269 (1856). *Plantago Purshii,* R. & S.

Frequent on dry, gravelly hillsides in the Laramie range. Observed only in the eastern part of the state.

Laramie, August, 1891 ; Wheatland, July, 1891 ; Table Mountain, June 28, 1895 (No. 1356).

Plantago Tweedyi, Gray, Syn. Fl. II, Part i, 390 (1886).

Three specimens only of this very rare plant were secured on a grassy hillside near the La Plata Mines, August 21, 1895 (No. 1798).

I am not aware that any other specimens have been collected since it was originally collected on the Yellowstone River by Mr. Frank Tweedy.

Oxybaphus angustifolius, Sweet. Hort. Brit. 429 (1830). *Allionia linearis,* Pursh.

Never abundant, only scattering specimens, often in cultivated ground.

Wheatland, July 9, 1894 (No. 379); Cottonwood Canon, August 4, 1895 (No. 1560); also from Sheridan, September, 1895.

Oxybaphus hirsutus, Choicy in DC. Prodr. xiii, part 2, 433 (1849). *Allionia hirsuta,* Pursh.

Rare ; noted but once ; Whalen Canon, July 18, 1894 (No. 515).

Oxybaphus nyctagineus, Sweet. Hort. Brit. 429 (1830). *Allionia nyctaginea,* Michx.

Very rare, unless it be in the northeastern part of the state.

Fairbanks, July 14, 1894 (No. 469).

Abronia fragrans, Nutt. Hook. Kew. Journ. Bot. v, 261 (1853).

Frequent on the sandy plains of the eastern part of the state.

Inyan Kara Divide, August 29, 1892 ; Platte River, July 14, 1894 (No. 464); Cummins, July 28, 1895 (No. 1473).

Abronia micrantha, Torr.

Very rare; on the plains and hillsides; by children called the *Sand Flower.*

Near Willow Creek, July 22, 1894 (No. 630).

ILLECEBRACEÆ.

Paronychia Jamesii, T. & G. Fl. N. A. i, 170 (1838).

Frequent on dry, open slopes in the Laramie range.

Fairbanks, July 14, 1894 (No. 451); also near Laramie Peak.

Paronychia pulvinata, Gray, Proc. Acad. Phila. 1863, 58.

Infrequent and strictly alpine; on the naked summits of the Medicine Bow Mountains, August 23, 1895 (No. 1824).

Paronychia sessiliflora, Nutt. Gen. i, 160 (1818).

Common on the slopes about Laramie Peak, August 8, 1895 (No. 1638); observed in some other localities.

Paronychia sp.

Numbers 349, 461, 1331 and 1656 have for the present been laid aside. They represent at least two species not given above, but for want of sufficient literature they are now passed over.

AMARANTACEÆ.

Amarantus albus, L. Sp. Pl. Ed. 2, 1404 (1763).

A troublesome weed in most of our fields and gardens.

Popo Agie River, August 3, 1894 (No. 740); Sheridan Experiment Farm, September 1895.

Amarantus blitoides, Wats. Proc. Am. Acad. xii, 273 (877).

This too would find a place even in a very short list of the worst weeds.

Laramie, September 24, 1894 (No. 1176); Sheridan, September, 1895.

Amarantus chlorostachys, Willd. *A. hybridus,* L.

Some specimens, apparently this, were collected by B. C. Buffum, at Inyan Kara Divide, August 30, 1892.

Amarantus retroflexus, L. Sp. Pl. 991 (1753).

Where weeds run riot this will always be found.

Laramie, October, 1893; Lander, August 3, 1894 (No. 715).

Amarantus Torreyi, Benth. Wats. Bot. Cal. ii, 42 (1880).

Infrequent; near Rawlins, June 29, 1892.

CHENOPODIACEÆ.

Cycloloma platyphyllum, Moq. Enum. Chenop. 18 (1840). *C. atriplicifolium*, Coulter.

Frequent in the sandy canons leading to the Platte, near Fairbanks, July 14, 1894 (No 471).

Monolepsis chenopodioides, Moq. DC. Prodr. xiii, part 2, 85 (1849). *Monolepsis Nuttalliana*, Greene.

Frequent in saline ground.

Laramie, August, 1893; Boulder Creek, August 26, 1894 (No. (1103).

Chenopodium album, L. Sp. Pl. 219 (1753).

In waste and cultivated ground.

Laramie, October, 1893; Sheridan Experiment Farm, September, 1895. *Pigweed.*

Chenopodium capitatum, Watson, Bot. Cal. ii, 48 (1880).

Infrequent; leaves only, from Cummins, July 27, 1895 (No. 1448).

Chenopodium Fremontii, Watson, Bot. King's Exp. 287 (1871).

Abundant on dry hillsides and on rocky shelving ledges.

Fairbanks, July 13, 1894 (No. 440).

Chenopodium glaucum, L. Sp. Pl. 220 (1753).

Apparently indigenous in places, but scattering everywhere as a weed.

Poison Spider Creek (native ?), July 27, 1894 (No. 625); among the weeds at Laramie and Sheridan.

Chenopodium leptophyllum, Nutt. Moq. DC. Prodr. xiii, part 2, 71 (1849).

Not infrequent near the Platte and its tributaries; Laramie, August 15, 1893; Platte River, July 14, 1894 (No. 483).

Chenopodium leptophyllum subglabrum, Wats. Proc. Am. Acad. ix, 95.

Rare; Willow Creek, July 22, 1894 (No. 628).

Chenopodium olidum, Watson, Proc. Am. Acad. ix, 96.

In saline ground on Poison Spider Creek, July 27, 1894 (No. 622); also sent from the Sheridan Experiment Farm as a weed, 1895.

Chenopodium rubrum humile, Watson, Bot. Cal. ii, 48.

Some specimens from Laramie, by B. C. Buffum, June 23, 1894, seem to belong here. Not observed elsewhere.

Atriplex argentea, Nutt. Gen. i, 198 (1818).

Throughout the state; reported as a weed from some localities.

Big Muddy Creek, July 24, 1894 (No. 640); Meadow Creek, August 9, 1894 (No. 791); Sheridan, September, 1895.

Atriplex canescens, James, Wats. Proc. Am. Acad. ix, 110 (1874).

Not frequent; observed only on the east side of the Laramie range.

Wheatland, August 11, 1891; Platte Hills, Fairbanks, July 14, 1894 (No. 463).

Atriplex confertifolia, Watson, l. c.

A common shrub on the alkali deserts of the central and southwestern parts of the state. Frequently called *White Sage* and is said to be freely eaten by antelope and sheep during the winter months.

Rock Springs, September 9, 1893; Bessemer, July 26, 1894 (No. 613).

Atriplex expansa, Watson, Proc. Am. Acad. ix, 116 (1874).

Very abundant in the vicinity of alkali lakes.

Howell Lakes, October 1, 1894 (No. 1164).

Atriplex Nuttallii, Watson, l. c.

Luxuriant in strongly saline ground.

Alkali Desest, July 2, 1891; Howell Lakes, October 1, 1894 (No. 1167); alkali flats near Sweetwater River, September 10, 1894 (No. 1192).

Atriplex patula hastata, Gray, Man. Ed. 5, 409 (1867). *A. hastata.* L.

Abundant near Laramie and probably in many other localities. September 1, 1895 (No. 1866), The form with ovate entire leaves was secured at the same time.

Atriplex truncata, Gray, Proc. Am. Acad. viii, 398.

I think there is little doubt of the correctness of this reference.

Rather immature specimens from Poison Spider Creek, July 26, 1894 (No. 621); older at Howell Lakes, October 1, 1894 (No. 1166).

Eurotia lanata, Moq. Enum. Chenop. 81 (1840).

Very frequent and abundant in many localities.

Fairbanks, July 14, 1894 (No. 488); Laramie, September 12, 1894 (No. 1134).

Salicornia herbacea, L. Sp. Pl. 3 (1762).

Abundant on the shores of alkali lakes, even on the encrusted banks where nothing else will grow.

Howell Lakes, October 1, 1894 (No. 1162); Laramie, September 3, 1895 (No. 1869).

Sueda depressa, Watson, Bot. King's Exp. 294 (1871).

Not noted except at Howell Lakes, October 1, 1894 (No. 1163).

Sueda depressa erecta, Watson, Proc. Am Acad. ix, 90 (1874).

Not frequent; on an alkali bog on Poison Spider Creek, July 27, 1894 (No. 623).

Sueda diffusa, Watson, Proc. Am. Acad. ix, 88 (1874).

This is common on wet, saline ground.

Popo Agie River, August 4, 1894, (No. 717); Sheridan, September, 1895, J. F. Lewis.

Sueda Torreyana, Watson, Proc. Am. Acad. ix, 88 (1874).

Only collected at Howell Lakes, but probably elsewhere as well. October 1, 1894 (No. 1168).

Salsola Kali Tragus, Moq. in DC. Prodr. xiii, part 2, 187 (1849).

This, the much talked of *Russian Thistle*, is already quite widely distributed in the northeastern part of the state. Other plants are frequently mistaken for it and so it has often been reported from localities in which it does not exist. There is no evidence to show that it is found on the line of the Union Pacific railroad except at Cheyenne. On the lines of the Burlington & Misssouri and the Elkhorn roads, however, I am reliably informed that it is widely distributed.

Specimens from Cheyenne, October, 1894 ; from Lusk and Fredericks in 1895.

Sarcobatus vermiculatus, Torr., Emory's Rep. 150 (1848).

The most characteristic shrub of the saline plains and foothills.

Sweetwater River, September 9, 1894 (No. 1182); Howell Lakes, October 1, 1894 (No. 1161). *Grease Wood.*

POLYGONACEÆ.

Eriogonum alatum, Torr. Sitgreaves Rep. t. 8 (1853).

Noted only on the foothills of the Laramie range and the adjoining plains ; abundant.

Cheyenne, August 11, 1891; Laramie Hills, July 9, 1894 (No. 416).

Eriogonum annuum, Nutt. Trans. Am. Phil. Soc. (II) 5: 164 (1833-37).

Infrequent in parts of state collected.

Inyan Kara Divide, September 1, 1892; Willow Creek, July 20, 1894 (No. 566).

Eriogonum brevicaule, Nutt.

Immensely abundant throughout the state on clayey, gravelly ridges and plains.

Laramie Hills, July 8, 1894 (No. 303); Wind River, August 8, 1894 (No. 722); from several other localities.

Eriogonum cæspitosum, Nutt. Journ. Acad. Phil. vii, 50 (1834).

Very rare; Union Pass, August 14, 1894 (No. 890).

Eriogonum cernuum, Nutt. Journ. Acad. Phil. (II) 1 : 162 (1848).

Widely distributed and abundant.

Laramie Hills, July 7, 1894 (No. 363); Wind River, August 8, 1894 (No. 726).

Eriogonum chrysocephalum, Gray, Proc. Am. Acad. xi, 101.

Rare; possibly confined to the Pacific Slope.

Bacon Creek, August 15, 1894 (No. 903).

Eriogonum flavum, Nutt., Fras. Cat. (1813).

Common on hillsides in the Laramie and Medicine Bow ranges.

Laramie Hills, July 8, 1894 (No. 415); Cummins, July 27, 1895 (No. 1443); a very large form with compound umbels from Laramie Peak, August 5, 1895 (No. 1572).

Eriogonum flavum crassifolium, Benth.

Frequent in the Laramie foothills. Name communicated by Dr. Robinson; citation not at hand.

Laramie Hills June 6, 1894 (No. 186).

Eriogonum heracleoides, Nutt. Journ. Acad. Phila. vii, 49 (1834).

Infrequent; our specimens are not typical but they undoubtedly must be placed here.

Wallace Creek, July 29, 1894 (No. 677).

Eriogonum microthecum, Nutt. Journ. Acad. Phila. (II) 1 : 162 (1848).

Both frequent and abundant.

Laramie at various times (Nos. 329 and 1138); Sweetwater, September 12, 1894 (No. 1188).

Eriogonum ovalifolium, Nutt. Journ. Acad. Phila. vii, 50 (1834).

In dry sandy soil on the plains; frequent.

Laramie, May 29, 1894 (No. 70); Hutton ranch, June 19, 1894 (No. 278).

Eriogonum subalpinum, Greene, Pitt. xiii, part 13, 18 (1896).

This recently described species, founded, seemingly, on unimportant characters I believe to be a valid one. The eight specimens in our herbarium labelled *E. umbellatum* fall readily into the two groups made by Prof. Greene. At different times the writer has brought in the two forms from the field fully convinced that they were different and yet unable to separate them by any marked botanical characters, though so readily distinguished in the field.

Laramie Hills, July 7, 1894 (No. 346); Tetons, August 22, 1894 (No. 975); others from Laramie.

Eriogonum umbellatum, Torr. Ann. Lyc. N. Y. ii, 241 (1828).

Pole Creek, July 2, 1895 (No. 1419); Laramie Hills at various times.

Polygonum amphibium, L. Sp. Pl. 361 (1753).

Observed only in the Platte River near Fairbanks, but undoubtedly found elsewhere. July 15, 1894 (No. 551).

Polygonum aviculare, L. Sp. Pl. 362 (1753).

A common dooryard weed.

Laramie, September 24, 1894 (No. 1173). *Goose Grass.*

Polygonum bistortoides, Pursh, Fl. i, 217 (1814).

Frequent in grassy valleys.

Bald Mountain, August 15, 1892; Union Pass, August 11, 1894 (No. 1024).

Polygonum convolvulus, L. Sp. Pl. 364 (1753).

Waste and cultivated ground; Experiment Farm, September 15, 1894 (No. 1140); Popo Agie river, August 1, 1894 (No. 714).

Polygonum Douglasii, Greene, Bull. Cal. Acad. iii, 125 (1885)·

In dry ravines; Sybille Creek, July 7, 1894 (No. 307); Laramie Peak, August 7, 1895 (No. 1591).

Polygonum erectum, L. Sp. Pl. 363 (1753).

Infrequent; on the bank of Blue Grass Creek, July 8, 1894 (No. 364).

Polygonum hydropiper, L. Sp. Pl. 361 (1753).

In a wet place on the banks of a small stream near Lusk, July 21, 1894 (No. 576).

Polygonum minimum, Watson, Bot. King Surv. v, 315 (1871).

I refer our specimens to this with some doubt; they are larger than the type and less pubescent.

La Plata Mines, August 24, 1895 (No. 1833)

Polygonum nodosum, Pers. Syn. i, 440 (1805). *P. lapathifolium nodosum,* (Pers.) Small.

From Wheatland, August 1892, by B C. Buffum.

Polygonum Persicaria, L. Sp. Pl. 362 (1753).

As a weed on the Sheridan Experiment Farm, September 1895, by J. F. Lewis. *Smart Weed.*

Polygonum ramosissimum, Michx. Fl. Bor. Am. i, 237 (1803).

Frequent and variable, some of the specimens approaching *P. Tenue.*

Sugg's Road, August 20, 1892; Wallace Creek, July 29, 1894 (No. 671); Green River, August 14, 1894 (No. 888).

Polygonum viviparum, L. Sp. Pl. 360 (1753).

Frequent in the higher mountains.

Fort Laramie, September 5, 1892; Union Pass, August 11, 1894 (No. 842).

Oxyria digyna, Campd. Rum. 155, t. 3, f. 3 (1819)

Very frequent in shaded places and under overhanging cliffs, 8,000-9000 ft.

Garfield Peak, July 29, 1894 (No. 662); Laramie Peak, August 7, 1895 (No. 1620).

Rumex Crispus, L. Sp. Pl. 335 (1753).

Platte River, July 14, 1894 (No. 495); Laramie, September 20, 1894 (No. 1147).

Rumex maritimus, L. Sp. Pl. 335 (1753).

In saline soil; not frequent.

Clark's Ranch on Wind River, August 10, 1894 (No. 769); Sheridan, September 1895, J. F. Lewis.

Rumex occidentalis, Watson, Proc, Am. Acad. xii, 253 (1876).

Under this name are a number of specimens, some immature, and only the following typical:

Wallace Creek, July 29, 1894 (No. 561); Centennial Valley, August 16, 1895 (No. 1752).

Rumex paucifolius, Nutt. Ms. in Herb. Gray. *R. Geyeri,* (Meisn.) Trelease.

Abundant in subalpine parks; Union Pass, August 11, 1894 (No. 855); also observed in the Medicine Bow Mountains.

Rumex salicifolius, Weinm. Flora, iv, 28 (1813).

Frequent and somewhat variable in general appearance.

Whalen Canon, July 17 1894 (No. 561); Laramie, July 23, 1895 (No. 1449).

Rumex venosus, Pursh, Fl. Am. Sept. 733 (1814).

Frequent about sand dunes on the plains.

Laramie, June 3, 1894 (No. 156).

ELÆAGNACEÆ.

Eleagnus argentea, Pursh, Fl. Am. Sept. 114 (1814).

Very frequent on the Wind Rivers.

Fort Washakie, August 5, 1894 (No. 703).

Shepherdia argentea, Nutt. Gen. ii, 240 (1818). *Lepargyræa argentea,* (Nutt.) Greene. *Buffalo Berry.*

Common on the Platte; Bessemer, July 26, 1894 (No. 636).

Shepherdia Canadensis, Nutt. Gen. ii, 241 (1818). *Lepargyræa Canadensis,* (L.) Greene.

Common on moist and partially shaded slopes in the mountains.

Laramie Hills, May 12, 1894 (No. 25). Garfield Peak, July 29, 1894 (No. 687); Laramie Peak, August 5, 1895 (No. 1585).

LORANTHACEÆ.

Arceuthobium Americanum, Engelm. Pl. Lindl. ii, 214 (1850). *Razoumofskya Americana,* (Engelm.) Kuntze.

Infrequent; at Keystone, Medicine Bow Mountains, 1893, W. C. Knight.

SANTALACEÆ.

Comandra pallida, DC. Prodr. xiv, 636 (1857).

Frequent on dry slopes throughout the state.

Table Mountain, June 2, 1894 (No. 105); Gros Ventre River, August 18, 1894 (No. 1091).

EUPHORBIACEÆ.

Euphorbia dentata, Michx. Fl. Bor. Am. ii, 211 (1803).

Infrequent; observed but once; Hartville, July 15, 1894 (No. 549).

Euphorbia dictyosperma, Fisch. and Mey. Ind. Sem. Hort. Petrop. ii, 37 (1835).

On sand dunes near Mexican Mines, July 21, 1894 (No. 581).

Euphorbia Fendleri, T. & G. Pac. R. R. Rep. ii, 175 (1855).

Our *Euphorbias* seem to be confined to the warm sandy plains and canons of the eastern part of the state, particularly to the region of the Platte. This from Fairbanks, July 14, 1894 (No. 472).

Euphorbia glyptosperma, Engelm. Bot. Mex. Bound. Serv. 187 (1859).

Quite frequent; Wheatland, June 29, 1891; Blue Grass Hills, July 8, 1894 (No. 370).

Euphorbia hexagona, Nutt. Spreng. Syst. iii, 791 (1826).

In a sandy canon leading to the Platte, Fairbanks, July 13, 1894 (No. 436).

Euphorbia montana, Engelm. Bot. Mex. Bound. Surv. 192 (1859).

This is probably common throughout the state on stony, gravelly hillsides.

Inyan Kara Divide, August 29, 1892; Whalen Canon, July 18, 1894 (No. 529); Pole Creek, July 1, 1895 (No. 1400).

Euphorbia petaloidea, Engelm. l. c.

Not infrequent on sandy river bottoms.

Uva, July 10, 1894 (No. 399); Willow Creek, July 22, 1894 (No. 631).

Croton Texensis, Muell. Arg. in DC. Prodr. xv, part 2, 692 (1862).

On sandy river bottoms in the eastern part of the state.

Fairbanks, July 12, 1894 (No. 428); also at Fort Laramie.

URTICACEÆ.

Humulus Lupulus, L. Sp. Pl. 1028 (1753).

Not infrequent in copses on river bottoms and in ravines.

Whalen Canon, July 18, 1894 (No. 513). *Wild Hops.*

Urtica Breweri, Watson, Proc. Am. Acad. x, 348 (1875).

Abundant in Centennial Valley; not observed elsewhere; June 8, 1895 (No. 1273); August 25, 1895 (No. 1862). *Nettle.*

Urtica gracilis, Ait. Hort. Kew. iii, 341 (1789).

Exceedingly abundant in copses on most streams.

Mexican Mines, July 20, 1894 (No. 590).

Parietaria Pennsylvanica, Muhl. Willd Sp. Pl. iv, 955 (1805).

Infrequent; Fairbanks, July 13, 1894 (No. 441).

CUPULIFERÆ.

Betula glandulosa, Mich. Fl. Bor. Am. ii, 180 (1803),

On the stony banks of subalpine streams.

Warm Spring Creek, August 10, 1894 (No. 799). *Mountain Birch.*

Betula occidentalis, Hook. Fl. Bor. Am. ii, 155 (1839).

Supposedly common on our streams, especially in the northeast, but only collected at Laramie Peak, August 8, 1895 (No. 1647). *Western Birch.*

Alnus incana virescens, Wats. Bot. Cal. ii, 81 (1880).

Frequent and abundant on our mountain streams, sometimes attaining the size of small trees.

Big Wind River, August 8, 1894 (No. 728); Cummins, July 29, 1895 (No. 1531); also in Centennial Valley. *Alder.*

Quercus undulata, Torr. Ann. Lyc. N. Y. ii, 248 (828).

This is reported abundant in the Black Hills, to which region it is probably confined; so far as known it is our only *Oak.*

Sundance, July 22, 1891, by B. C. Buffum.

SALICACEÆ.*

Salix arctica petræa, Anders.

Infrequent; not observed by the writer.

Collected by B. C. Buffum, Bald Mountain, August 15, 1892.

Salix alba x fragllis, Wienmer.

This Hybrid is among those in the City Park, October 1, 1894 (No. 1199).

Salix amygdaloides, Anders. Ofv. Handl. Vet. Akad. 1858, 114 (1858).

Typical specimens from Snake River, August 21, 1894 (No. 978). My specimens from Big Popo Agie River, August 2, 1894 (No. 738) were designated by Mr. Bebb as "*forma sat singularis,*" on account of the occurrence in the same individual of the following peculiarities: Leaves unusually short and broad, coarsely serrate and very conspicuously stipulate.

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* The *Willows* were in large part determined by the late Mr. Bebb; those collected in 1895 only, by Mr. M. L. Fernald.

Salix candida, Fleugge, Willd. Sp. Pl. iv, 708 (1806).

Observed only in Centennial Valley, August 20, 1895 (No. 1755).

Salix chlorophylla, Anders. Monogr. 138 (1867).

Widely distributed; Union Pass, August 13, 1894 (No. 1029); Centennial Valley, August 19, 1895 (No. 1741).

Salix cordata, Muhl. Neue Schr. Ges. Nat. Fr. Berlin, iv, 236 (1803).

Collected but once; Laramie Peak, August 6, 1895 (No. 1598).

Salix curtiflora, (Anders) Bebb.

This very rare plant from two localities; not reported from this state before, I think, except by Mr. Tweedy.

Boulder Creek, August 26, 1894 (No. 1122); Centennial Valley, August 19, 1895 (No. 1754).

Salix desertorum, Rich. App. Frank. Journ. 371 (823).

On a hummocky heath in Centennial Valley, August 20, 1895 (No. 1759).

Salix desertorum elata, Anders.

Rare, alpine; Union Peak, August 13, 1894 (No. 1072); LaPlata Mines, August 22, 1895 (No 1818).

Salix desertorum fruticulosa, Anders.

Infrequent in an open, heathlike park in Union Pass, August 11, 1894 (No. 913).

Salix flavescens, Nutt. Sylv. i, 65 (1842-53).

This beautiful species is the first to put out its blossoms of all our willows; the leaves follow very tardily.

Thus far noted only in the Laramie range; Pole Creek, May, 12, 1894 (No. 24) and at various other times; Laramie Peak, August 6, 1895 (No. 1586).

Salix lasiandra Fendleriana, (Anders.) Bebb.

Not infrequent; Popo Agie River, August 2, 1894 (No. 737); Pole Creek, June 30, 1895 (No. 1434).

Salix leucosericea, Nob. n. sp.

In communicating this name to me Mr. Bebb made the following comments upon the species: " It will shortly appear as above in a government report. This is the Rocky Mountain or plateau member of a group which has for its eastern or Atlantic coast representatives, *S. sericea* and *S. petiolaris*, and for the Pacific coast *S. macrocarpa*."

Rare; observed only on Boulder Creek, August 26, 1894 (No. 1123).

Salix longifolia, Muhl. Neue Schr. Ges. Nat. Fr. Berlin, iv, 238 (1803).

On sand bars and creek banks everywhere, common and variable.

Laramie, June 16, 1894 (No. 245); near Lander, August 3, 1894 (No. 718); Cummins, July 26, 1895; (No. 1447).

Salix macrocarpa, Nutt.

I suppose this to be very rare in the state.

Centennial Valley, June, 9, 1895 (No. 1255).

Salix monticolo, Bebb.

Infrequent; Centennial Valley, August 18, 1895 (No. 1733).

Salix rostrata, Richards, Frank. Journ. App. 753 (1823).

Our commonest *Willow*.

Laramie, June 16, 1894 (No. 244); Centennial Valley, June 9, 1895 (No. 1303); also a low mountain form from Little Sandy, August 30, 1894 (No. 1130).

Salix sp.

Only foliage but clearly enough not any of the foregoing.

Populus acuminata, Rydberg, Bull. Torr. Club, xx, 50 (1893).

Our handsomest *Cottonwood* as well as the most rapid growing of our shade trees; planted extensively in Laramie.

Fine native specimens in Whalen Conon, July 17, 1894 (No. 560). *Rydberg's Cottonwood.*

Populus angustifolia, James, Long's Exp. i, 497 (1823).

This is very frequent on the principal streams of the state, in places forming considerable bordering groves, individual trees attaining great size.

Laramie, May 16, 1894 (No. 39). *Black Cottonwood.*

Populus balsamifera, L. Sp. Pl. 1034 (1753).

This is not frequent and I have not seen it except as single trees here and there.

Dubois, August 9, 1894 (No. 749); Cummins, July 29, 1894 (No. 1547).

Populus monilifera, Ait. Hort Kew. iii, 406 (1789).

This species is used to some extent for shade purposes. If native in the state I have not yet observed it.

Populus tremuloides, Michx. Fl. Bor. Am. ii, 243 (1803).

The *Quaking Asp* of the canons and hillsides, usually only a large shrub but in some places attaining considerable size as trees.

Laramie Hills, May, 12, 1894 (No. 23); noted in scores of other places.

HYDROCHARITACEÆ.

Elodea Canadensis, Michx. Fl. Bor. Am. i, 20 (1803). *Udora Canadensis,* Nutt.

In the ponds and springs on the Fish Hatchery grounds where it has probably been introduced. October 18, 1893.

ORCHIDACEÆ.

Calypso borealis, Salisb. Parad. Lond. t. 89 (1807). *C. bulbosa;* (L.) Oakes.

This beautiful little *Orchid* is as rare here as elsewhere. The following students each found one specimen on a partly wooded hillside at the head of Pole Creek, May 25, 1894 (No. 61): Lily Boyd, Tessie Welch and Ben Bartlett.

Listera convallarioides, (Sw.) Torr. Comp 320 (1826).

Very rare, only observed once; Centennial Valley, August 17, 1895 (No. 1694).

Spiranthes Romanzoffiana, Cham. Linnæa, iii, 32 (1828). *Gyrostachys Romanzoffiana,* (Cham.) MacM.

Abundant in a few localities; Centennial Valley, August 10, 1895 (No. 1663).

Habenaria gracilis, (?) Watson.

The following numbers, (420 and 1706) appear in our herbarium as *H. hyperborea,* but re-examination shows that they should probably be referred as above. Frequent in marshy places.

Chugwater Creek, July. 7, 1894; Centennial-Hills, August 17, 1895.

Habenaria hyperborea, R. Br. in Ait. Hort. Kew, Ed. 2, v, 203 (1813).

Specimens only from Big Wind River, August 8, 1894 (No. 725).

Habenaria obtusata, Richards. App. Frank. Journ. 750 (1823).
Very rare; Cummins, July 30, 1895 (No. 1544).

IRIDACEÆ.

Iris Missouriensis, Nutt. Journn. Acad. Phila. vii, 58 (1834).

Frequent on creek and river bottoms.

Laramie, June 18, 1894 (No. 260); Centennial Valley, June 9, 1895 (No. 1268).

Sisyrinchium Bermudiana, L. Sp. Pl. 954 (1753).

The specimens before me show the characters which were supposed to separate *S. angustifolius* and *S. mucronatum*, but the length of the spathes and the breadth of the wings are far from constant. It is well to unite them under this earlier name.

Laramie, June 1894 (No. 239); Wind River, at Dubois, August 10, 1894 (No. 767); in various other places.

LILIACEÆ.

Streptopus amplexifolius, DC. Fl. Fran. iii, 174 (1805).

In copses on mountain sides; Laramie Hills, June 28, 1891; Laramie Peak, August 6, 1895 (No. 1580).

Smilacina amplexicaulis, Nutt. Journ. Acad. Phil. vii, 58 (1834). *Vagnera amplexicaulis*, (Nutt.) Greene.

Very rare; thus far only observed on Casper Mountain, July 26, 1894 (No. 610).

Smilacina stellata, Desf. Ann. Mus. Paris, ix, 52 (1807). *Vagnera stellata*, (L.) Greene.

Frequent and abundant in the meadows bordering on all our streams.

Horse Creek, June 9, 1894 (No. 155); Platte River, July 24, 1894 (No. 632).

Yucca angustifolia, Pursh. Fl. Am. Sept. 227 (1814). *Y. glauca*, Nutt.

Frequent on sandy, gravelly hillsides.

Cummins, July 27, 1895 (No. 1460). *Spanish Bayonet.*

Leucocrinum montanum, Nutt, Gray, Ann. N. Y. Lyc. iv, 110 (1837).

Very common on the plains and foothills.

Laramie, May 15, 1894 (No. 1226); also from Table Mountain. *White Mountain Lily.*

Allium acuminatum, Hook. Fl. Bor. Am. ii, 184, t. 146 (1840).

On the Platte River, 1891, B. C. Buffum.

Allium brevistylum, Watson, Bot. King Exp. 350 (1871).

Frequent in rich loam soil in copses.

Big Horn Mountains, July 1892; Centennial Hills, August 1895 (No. 1704).

Allium cernuum, Roth. Roem. Arch. Bot. i, part 3, 40 (1798).

Very frequent; Inyan Kara Divide, August 31, 1892; Garfield Peak, July 29, 1894 (No. 661); Laramie Peak, August 7, 1895 (No. 1633).

Allium Nuttallii, Wats. Proc. Am. Acad. xiv, 227 (1879).

Not infrequent on gravelly river bottoms and hillsides.

Laramie, June 19, 1894 (No. 263); Pole Creek, June 30, 1895 (No. 1382).

Allium reticulatum, Don. Mem. Wern. Soc. vi, 36 (1826-31).

The earliest and commonest *Wild Onion* on the plains.

Laramie, June 15, 1894 (No. 222); Pole Creek, June 29, 1895 (No. 1353).

Allium Schœnoprasum, L. Sp. Pl. 301 (1753).

In wet places in the mountains.

Green River, August 15, 1894 (No. 907); La Plata Mines, August 23, 1895 (No. 1788).

Fritillaria atropurpurea, Nutt. Journ. Acad. Phila. vii. 54 (1834).

This is very rare; single specimens from the east slope of the Laramie Hills in June by B. C. Buffum, and on two occasions by Noah Wallis.

Erythronium grandiflorum, Pursh. Fl. i, 231 (1814).

Infrequent; alpine or at least subalpine.

Bald Mountain, August 16, 1892; La Plata Mines, August 22, 1895 (No. 1796).

Calochortus Gunnisoni, Wats. Bot. King's Exp. 348 (1871).

Among the sage brush in the valleys.

Sybille Creek, July 8, 1894 (No 319); Cummins, July 26, 1895 (No. 1451).

Calochortus Nuttallii, T. & G. Pac. R. R. Rep. ii, 124 (1855).

In similar locations and nearly resembling the preceding but for the anthers and glands.

Laramie Hills, June 18, 1891; also July 7, 1894 (No. 413).

Disporum trachycarpum, B. & H. Gen. Pl. iii, 832 (1883).

In copses on mountain rivulets.

Casper Mountain, July 26, 1894 (No. 609); Centennial Valley, June 9, 1895 (No. 1277).

Zygadenus elegans, Pursh. Fl. Am. Sept. 241 (1814).

Frequent; in wet, grassy places near streams.

Chugwater Creek, July 7, 1894 (No. 421); Cummins, July 27, 1895 (No. 1453).

Zygadenus Nuttallii, Wats. Proc. Am. Acad xiv, 279 (1879).

Abundant on sandy plains and in the foothills.

Laramie, June 16, 1894 (No. 254); observed in many localities.

COMMELINACEÆ.

Tradescantia Virginiana, L. Sp. Pl. 288 (1753).

Probably confined to the eastern part of the state.

Platte River, July 14, 1894 (No. 492).

JUNCACEÆ.*

Juncus Balticus, Willd. Berlin Mag. iii, 298 (1809).

Very frequent in wet ground near streams.

Laramie, June 16, 1894 (No. 243).

Juncus bufonius, L. Sp. Pl. 328 (1753).

Frequent about spring bogs and in occasionally flooded ditches.

Cold Springs, Fairbanks, July 13, 1894 (No. 437); Centennial Valley, August 25, 1895 (No. 1851).

Juncus longistylis, Torr. Bot. Mex. Bound. Surv. 223 (1859).

Infrequent; Centennial Valley, August 18, 1895 (No. 1716).

Juncus Mertensianus, Bong.

This is of frequent occurrence in the higher mountains.

La Plata Mines, August 22, 1895 (No. 1791).

Juncus nodosus, L. Sp. Pl. Ed. 2, 466 (1762).

Frequent; Laramie, September 1892; Little Sandy, July 1892; Wolf Creek, August 1892, by B. C. Buffum.

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* For some further notes upon this and the order *Cyperaceæ*, see Bulletin No. 16 of this Station, by B. C. Buffum.

Juncus Parryi, Engelm. Trans. St. Louis Acad. ii, 447 (1866).

Alpine; Teton Mountains, August 21, 1894 (No. 981); La Plata Mines, August 24, 1895 (No. 1831).

Juncus subtriflorus, (Mey.) Coville, Contrib. Natl. Herb. iv, 208 (1893).

La Plata Mines, at about 11,000 ft., August 23, 1895 (No. 1812).

Juncus tenuis, Willd. Sp. Pl. ii, 214 (1799).

Lander, August 3, 1894 (No. 699).

Juncus tenuis congesta, Engelm. Trans. St. Louis Acad. ii, 446 (1866).

Infrequent; Laramie Peak, August 7, 1895 (No. 1631).

Juncus Torreyi, Coville.

Cold Springs, July 14, 1894 (No. 449); Teton Mountains, August 21, 1894 (No. 956).

Juncus xiphioides montanus, Engelm. Trans. St. Louis Acad. ii, 481 (1868).

Centennial Valley, August 18, 1895 (No. 1731).

Luzula spadicea parviflora, Meyer, Linnæa, xxii, 402 (1849). *Juncoides parviflorum,* (Ehrh.) Coville.

Not infrequent; Union Pass, August 11, 1894 (No. 846).

Luzula spadicea subcongesta, Watson, Bot. Cal. ii, 202.

In boggy places and partially dried up ponds.

Centennial Valley, August 16, 1895, and June 9, 1895 (No. 1261).

Luzula spicata, DC. Fl. Fr. iii, 161 (1805). *Juncoides spicatum,* (L.) Coville.

Alpine; Union Pass, August 11, 1894 (No. 847); noted also in the Medicine Bow Mountains

TYPHACEÆ.

Typha latifolia, L. Sp. Pl. 971 (1753).

Common in the margins of lakes and ponds.

Popo Agie River, August 1, 1894 (No. 734); abundant in the vicinity of Laramie.

ALISMACEÆ.

Alisma Plantago, L. Sp. Pl 342 (1753).

Rare; not observed by the writer.

Dutch Creek, Sheridan County, 1892, by B. C. Buffum.

Sagittaria arifolia, (?) Nutt. in Herb. *S. variabilis minor,* Pursh.

I have some hesitancy in referring it as above, but it is the best disposition I can make of it at present.

Collected in a marshy meadow stream near Lusk, July 21, 1894 (No. 577).

Sagittaria latifolia, Willd. Sp. Pl. iv, 409 (1806).

Probably rare; Wheatland, August 11, 1891, B. C. Buffum.

NAIADACEÆ.

Triglochin maritima, L. Sp. Pl. 339 (1753).

Common in alkali marshes.

Alkali Springs, July 30, 1894 (No. 745); also from Wind River, Laramie and other localities.

Triglochin palustris, L. Sp. Pl. 388 (1753).

In similar locations; Wind River, August 8, 1894 (No. 759).

Potamogeton pectinatus, L. Sp. Pl. 127 (1753).

In the Laramie River, August 9, 1895 (No. 1668.)

CYPERACEÆ.

Eleocharis compressa, Sull. Am. Journ. Sci. lxii, 50 (1842). *E. acuminata,* (Muhl.) Nees.

As yet only from the Big Horn Mountains, July 1892, B. C. Buffum.

Eleocharis olivacea, Torr. Ann. Lyc. N. Y. iii, 300 (1836).

Not infrequent in partially submerged ground.

Laramie, June 28, 1894 (No. 289); Cold Springs, July 14, 1894 (No. 455).

Eleocharis ovata, Roem. & Schult. Syst. ii, 152 (1817).

Specimens in the World's Fair collection secured in 1892.

Scirpus atrovirens, Muhl. Gram. 43 (1817).

Very common in marshy ground about springs and ponds.

Mexican Mines, July 20, 1894 (No. 591); Muddy Creek, August 25, 1894 (No. 1109).

Scirpus lacustris, L. Sp. Pl. 48 (1753).

Rare; noted only at Cold Springs, Fairbanks, July 14, 1894 (No. 454).

Scirpus pungens, Vahl. Enum ii, 255 (1806). *S. Americanus,* Pers.

Frequent; Cold Springs, Fairbanks, July 14, 1894 (No. 450).

Scirpus sylvaticus digynus, Bœckl. Linnæa, xxxvi, 727 (1870). *S. microcarpus,* Presl.

Infrequent; excellent specimens from Laramie Peak, August 6, 1895 (No. 1605).

Eriophorum polystachyon, L. Sp. Pl. 52 (1753).

Infrequent; Crazy Woman Creek, August 7, 1892, B. C. Buffum.

Carex alpina, Sw. Lilj. Sv. Fl. Ed. 2, 26, (1798).

Probably rather rare; head of Crazy Woman Creek, August 7, 1892.

Carex athrostachya, Olney, Proc. Am. Acad. vii, 393 (1868).

From Saratoga, August 1892.

Carex atrata, L. Sp. Pl. ii, 976 (1753).

Infrequent; alpine; La Plata Mines, August 23, 1895 (No. 1811).

Carex aurea, Nutt. Gen. ii, 205 (1818).

Rare; Wolf Creek, August 18, 1892, B. C. Buffum.

Carex canescens, L. Sp. Pl. 974 (1753).

Centennial Hills, August 18, 1895 (No. 1730).

Carex deflexa media, Bailey, Mem. Torr. Club. i, 42 (1889).

Big Sandy, July 1892, B. C. Buffum.

Carex Douglasii, Boott. Hook. Fl. Bor. Am. ii, 213, t. 214 (1840).

Secured in the Big Horn Mountains, August 8, 1892, B. C. Buffum.

Carex festiva. Dew. Am. Journ. Sci. xxix, 246 (1836).

Very abundant and apparently throughout the state.

Big Sandy, July, 1892; Laramie, June 28, 1894 (No. 288); also from Laramie Peak and Medicine Bow Mountains, in 1895 (Nos. 1615 and 1786).

Carex filifolia, Nutt. Gen. ii, 204 (1818).

Infrequent; Wheatland, August, 1891.

Carex geyeri, Boott. Trans. Linn. Soc. xx, 118 (1846).

Big Sandy, July, 1892, B. C. Buffum.

Carex Liddoni, Boott.

Big Horn Mountains, July 1892, B. C. Buffum.

Carex marcida, Boott. Hook. Fl. Bor. Am. ii, 212, t. 213 (1840).

In Carbon County, June 1892, B. C. Buffum.

Carex Nebraskensis, Dewey, Am. Journ. Sci. (II) xviii, 102 (1854).

This is a very common species in wet soil everywhere, even in soils with a considerable percentage of alkali; Laramie, June 19, 1894 (No. 274); Table Mountain, June 2, 1894 (No. 130).

Some specimens by B. C. Buffum are marked *C. Nebraskensis prævia*, Bailey, and it is not clear from the specimens nor from the literature at hand that they are different from the species.

Carex occidentalis, Bailey.

Apparently rare; Laramie Peak, August 6, 1895 (No. 1614).

Carex Pennsylvanica, Lam. Encycl. iii, 388 (1789).

Common on fertile hillsides among sage brush and other undershrubs.

Crook county August, 1892; Pole Creek, May 25, 1894 (No. 69).

Carex pratensis, Drejer, Rev. Crit. Car. Bor. 24 (1841).

Head of Crazy Woman Creek, August 8, 1892, B. C. Buffum.

Carex Raynoldsii, Dew. Am. Journ. Sci. xxxii, 39 (1837).

Infrequent; Bald Mountain, August 15, 1892, B. C. Buffum.

Carex siccata, Dew. Am. Journ. Sci. x, 278 (1826).

Abundant in native meadows on alkali soil.

Laramie, June 1, 1894 (No. 65).

Carex stenophylla, Wahl. Kongl. Acad. Handl. (II.) xxiv, 142 (1803).

Exceedingly abundant on the Laramie Plains in both dry and wet soil, the earliest *Sedge*, springing up as almost the first vegetation.

Laramie, May 16, 1894 (No. 19); at various other times.

Carex straminea brevior, Dew.

Rare; Lusk, July 21, 1894 (No. 586).

Carex straminea mirabilis, (Dew.) Tuck. Enum. Meth. 18 (1843).

Specimens communicated by J. F. Lewis, of the Sheridan Experiment Farm, September 1, 1895.

Carex tenella, Schk. Riedgr. 23, Fig. 104 (1801).

Some specimens from Wolf Creek, August 18, 1892, B. C. Buffum.

Carex Tolmiei, Boott.

Table Mountain, June 2, 1894 (No. 100); also from the Big Horn Mountains, August 6, 1892, B. C. Buffum.

Carex utriculata, Boott. Hook. Fl. Bor. Am. ii, 221 (1840).

Infrequent; Muddy Creek, August 25, 1894 (No. 1108).

Carex utriculata minor, Boott. l. c.

This seems to be of more frequent occurrence than the species.

Saratoga, 1891, by J. D. Parker; Laramie River, in Laramie county, September, 1892, B. C. Buffum.

Carex sp.

Somewhat resembling *C. Nebraskensis*, but with culms several times as long as the leaves; spikes few, the terminal one much the longer.

Cold Springs, at Fairbanks, July 13, 1894 (No. 447).

GRAMINEÆ.*

Andropogon provincialis, Lam. Encycl. i, 376 (1783).

Common in the eastern part of the state.

Wheatland, July, 1892, B. C. Buffum.

Andropogon scoparius, Michx. Fl. Bor. Am. i, 57 (1803).

Frequent; Hartville, July 18, 1894 (No. 531); also by B. C. Buffum, 1892.

Panicum capillare, L. Sp. Pl. 58 (1753).

Common in all parts of the state.

Crook county, 1892; Fairbanks, July 15, 1894 (No. 553); Sheridan Experiment Farm, September 1, 1894. *Old Witch Grass.*

Panicum Crus-galli, L. Sp. Pl. 56 (1753).

Presumably introduced but often found where such introduction would not be suspected.

Cummins, July 29, 1895 (No. 1500); Sheridan, September 1, 1895, J. F. Lewis.

Panicum sanguinale, L. Sp. Pl. 57 (1753).

Very generally introduced. Lander, June 1892; noted in other localities.

Panicum scoparium, Lam. Encycl. iv, 744 (1797).

Infrequent; Whalen Canon, July 18, 1894 (No. 516).

Panicum virgatum, L. Sp Pl. 59 (1753).

Fort Laramie, September, 1892, B. C. Buffum; Sheridan, September, 1895.

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* The Grasses were determined in part by each of the following: Dr. W. J. Beal, Dr. F. Lamson-Scribner and Prof. B. C. Buffum. For further notes upon them see "Grasses and Forage Plants," Bulletin No. 16 of this Station, by B. C. Buffum.

Setaria viridis, Beauv. Agrost. 51 (1812). *Chamæraphis viridis,* (L.) Porter.

A troublesome weed in cultivated ground.

Wheatland, August 11, 1891. *Meadow Fox-tail.*

Cenchrus tribuloides, L. Sp. Pl. 1050 (1753).

Common on the sandy plains of the Platte.

Fort Laramie, September 5, 1892, B. C. Buffum. *Sand Bur.*

Phalaris arundinacea, L. Sp Pl. i, 55 (1753).

Collected in 1891 ; no other data.

Hierochloa borealis, R. & S.

Not frequent ; Bald Mountain, August 15, 1892.

Aristida purpurea, Nutt. Trans. Am. Phil. Soc. (II.) v, 145 (1833-37). A. *fasciculata,* Torr.

Whether specimens are typical or belong to one of the varieties of this species I am unable to say. This form is common in the state.

Wheatlaud, July, 1891 ; Whalen Canon, July 19, 1894 (No. 539).

Stipa comata, Trin. and Rupr. Mem. Acad. St. Petersb. (VI) v, 75 (1842).

Frequent on the plains and in dry valleys ; when mature an annoying and worthless grass.

Laramie, June 17, 1891 ; June 28, 1894 (No. 284).

Stipa spartea, Trin. Mem. Acad. St. Petersb. ser. 6, i, 82 (1829).

On the plains of the eastern part of the state, 1891.

Stipa viridula, Trin. Mem. Acad. St. Petersb. ser. 6, v, 39 (1836).

Big Sandy, Fremont county, July, 1892.

Oryzopsis exigua, Thurb. Bot. Wilkes Exp. 481.

Hitherto, it seems, reported only from Oregon and Washington.

Big Sandy, in the Wind River Mountains, July 22, 1892, B. C. Buffum.

Oryzopsis menbranacea, Vasey, Grasses S. W. part 2, t. 10 (1891).

Very abundant on the plains and in the foothills.

University Campus, September 16, 1894 (No. 1137); noted in many other places. *Mountain Rice.*

Muhlenbergia comata, Benth. Vasey's Cat. Grasses U. S. 39 (1885).

Spring Creek, Big Horn Mountains, August 5, 1892.

Muhlenbergia dumosa, Scrib. in Vasey, Contr. Nat. Herb. iii, 71.

Frequent in the eastern part of the state.

Wheatland, August 16, 1891.

Muhlenbergia glomerata, Trin. Unifl. 191 (1824). *M. racemosa,* (Michx.) B. S. P.

From Wolf Creek, Rawhide Creek and Fort Laramie, 1892, B. C. Buffum.

Muhlenbergia gracilis breviaristata, Vasey, Rothr. in Wheeler's Rep. vi, 284.

Plumbago Canon, July 1891.

Phleum alpinum, L. Sp Pl. 59 (1753).

Common in the alpine region of all our mountain ranges.

Union Pass, August 10, 1894 (No. 863); La Plata, August 22, 1895 (No. 1781). *Wild Timothy.*

Alopecurus geniculatus fulvus, (J. E. Smith) Scrib. List. Pterid & Sperm. 38 (1894).

Frequent; Whalen Canon, July 19, 1894 (No. 544); Centennial Valley, August 18, 1895 (No. 1721).

Sporobolus airoides, Torr. Pac. R. R. Rep. vii, part 3, 21 (1856).

Fort Washakie Hot Springs, July, 1892, B. C. Buffum.

Sporobolus asperifolius, Thurb. in Wats. Bot. Cal. ii, 269 (1880).

Probably infrequent; Cheyenne, August, 1891.

Sporobolus cryptandrus, Gray, Man. 576 (1848).

Rather frequent, on dry ridges.

Wheatland, September 8, 1892; Fairbanks, July 13, 1894 (No. 435).

Sporobolus cuspidatus, Scribn. Bull. Torr. Club, x, 63 (1882). *S. brevifolius,* (Nutt.) Scribn.

Fremont county, July, 1892.

Sporobolus heterolepis, Gray, Man. 576 (1848).

Crook county, August, 1892.

Agrostis alba, L. Sp. Pl. 63 (1753).

Common; Crook county, 1892; Laramie, October 6, 1894 (No. 1172).

Agrostis asperifolia, Trin. Mem. Acad. St. Petersb. Sci. Nat. ser. 6, 318 (1845).

Infrequent; Centennial Valley, August 18, 1895 (No. 1719).

Agrostis exarata, Trin. Unifl. 207 (1824).
Head of Rawhide Creek, August 1892.

Agrostis humilis, Vasey, Bull. Torr. Club, x, 21.
Alpine, in wet soil; La Platta Mines, August 23, 1895 (No. 1814).

Agrostis scabra, Willd. Sp. Pl. i, 370 (1798).
Frequent; Big Sandy, July, 1892; Albany county, September, 1891.

Calamagrostis Canadensis, Beauv. Agrost. 15 (1812).
Wind River Mountains, July, 1892.

Calamagrostis confinis, Nutt. Gen. i, 47 (1818).
Common; Centennial Valley, September 7, 1891; Laramie, September 30, 1894 (No. 1179).

Calamagrostis longifolia, Hook. Fl. Bor. Am. 241 (1840). *Calamovilfa longifolia*, (Hook.) Hack.
Frequent; Lander, July, 1892; Whalen Canon, July 9, 1894 (No. 536).

Calamagrostis Montanensis, Scribn.
Sheridan county, August, 1892.

Calamagrotis neglecta, (Ehrh.) Gærtn. Fl. Wett. i, 94 (1799).
Frequent; Big Horn Mountains, August, 1892; Orin Junction, August 14, 1891.

Calamagrostis pallida, Vasey & Scribn.
Eagle Rock Canon, September 22, 1891; also from Carbon county.

Calamagrostis purpurascens, R. Br., in Rich. Bot. App. Frank. Voy. 3.
Infrequent; Laramie Peak, August 7, 1895 (No. 1627).

Deschampsia cæspitosa, Beauv. Agrost. 160, t. 18, f. 3 (1812).
Common in the mountains; Big Sandy, July, 1892; La Plata Mines, August 23, 1895 (No. 1815).

Deschampsia cæspitosa arctica, Vasey.
Rare; Laramie Hills, June 12, 1894 (No. 238).

Trisetum subspicatum, Beauv. Agrost. 180 (1812).
Very abundant in the mountains; Big Sandy, July, 1892; La Plata Mines, August 22, 1895 (No. 1783).

Trisetum subspicatum molle, Gray, Man. Ed. 2, 572 (1856).
La Plata, Medicine Bow Mountains, August 23, 1895 (No. 1807).

Trisetum Wolfii, Vasey.
Fort Laramie, September 6, 1892, B. C. Buffum.

Danthonia Californica, Boland. Proc. Cal. Acad. ii, 182 (1862-63).

Sheridan county, August, 1892.

Danthonia intermedia, Vasey.

Big Sandy, Fremont county, July, 1892.

Danthonia unispicata, Munro. *D. Californica unispicata,* Thurb. Bot. Cal. ii, 294 (1880).

Apparently rare; Laramie Peak, August 7, 1895 (No. 1630).

Spartina cynosuroides, Willd Enum. Pl. 80 (1809).

Common and widely distributed; Inyan Kara Divide, August 30, 1892; C. Y. Ranch, on Big Muddy, July 23, 1894 (No. 599).

Schedonnardus Texanus, Steud. Syn. Pl. Gram. 146 (1855). *S. paniculatus,* (Nutt.) Scribn.

Abundant on the plains of the eastern part of the state.

Orin Junction, August, 1891.

Bouteloua oligostachya,Torr. Gray, Man. Ed. 2, 553 (1856).

A very common grass on the plains.

Wheatland, June 11, 1891; noted in many localities.

Bouteloua racemosa, Lag. Var. Clenc. y Litter. 2: Part 4, 141 (1805). *B. curtipendula,* (Michx.) Torr.

This, like the preceding, is very abundant in many localities.

Inyan Kara Divide, August 30, 1892; Hartville, July 18, 1894 (No. 530).

Beckmannia erucæformis, Host. Gram. Austr. iii, 5 (1805).

In swampy ground along our streams.

Big Sandy, July, 1892: Union Pass, August 11, 1894 (No. 828); Cummins, July 30, 1895 (No. 1533).

Buchloe dactyloides, Engelm. Trans. St. Louis Acad. i, 432 (1859). *Bulbilis dactyloides,* (Nutt.) Raf.

This is still found in considerable abundance on some of our plains, but it seems that it is gradually being killed out and replaced by other grasses.

Wheatland, September, 1892, and noted in many parts of the state. *Buffalo Grass.*

Munroa squarrosa, Torr. Pac. R. R. Rep. iv, 158 (1856).

Noted only in the eastern part of the state.

Wheatland, August, 1891; Blue Grass Creek, July 8, 1894 (No. 372).

Phragmites communis, Trin. Fund. Agrost. 134 (1820). *P. Phragmites*, (L.) Karst.

Not noted by the writer, but fine specimens by B. C. Buffum, from Little Muddy Creek, Casper, August 12, 1891. *Reed Grass.*

Eragrostis major, Host. Gram. Austr. 4: 14, t. 24 (1809).

Sparingly introduced about Wheatland and probably in other localities; September, 1892, B. C. Buffum.

Eatonia obtusata, Gray, Man. Ed. 2, 558 (1856).

Frequent; Crook county, August, 1892; Fairbanks, July 14, 1894 (No. 459).

Koeleria cristata, Pers. Syn. i, 97 (1812).

Common everywhere; Johnson county, August, 1892; Laramie, June 28, 1894 (No. 283), and noted in numerous localities.

Catabrosa aquatica, Beauv. Agrost. 157, t. 19, f. 8 (1812).

Throughout the state; Crook Creek, June 28, 1891; Cottonwood Canon, August 4, 1895 (No. 1567).

Melica bulbosa, Geyer.

Infrequent; Bald Mountain, August 16, 1892.

Distichlis maritima, Raf. Journ. Phys. lxxxix, 104 (1818). *D. spicata*, (L.) Greene.

Frequent on wet alkali flats.

Big Wind River, August 1, 1892; Alkali Springs, July 31, 1894 (No. 659).

Poa alpina, L. Sp. Pl. 67 (1753).

Rare, as well as rarely beautiful; Bald Mountain, August 15, 1892.

Poa andina, Nutt. Wats. Bot King Exp. 388 (1871). *P. arida*, Vasey.

Common on dry slopes; Middle Pass, June 21, 1892; Laramie, June 5, 1895 (No. 1245).

Poa Californica, Vasey, Cat. Grasses, U. S. 81 (1885). *P. Fendleriana*. (Steud.) Vasey.

Infrequent; Big Sandy, July, 1892.

Poa cæsia strictior, Gray.

Laramie Hills, June, 1892, B C. Buffum.

Poa cuspidata, Vasey.

Carbon county, June, 1892; La Plata Mines, August 22, 1895 (No. 1782).

Poa lævis, Vasey.

Carbon county, June, 1892.

Poa nemoralis, L. Sp. Pl. 69 (1753).

This is of frequent occurrence; Big Sandy, July, 1892; Laramie, June 19, 1894 (No. 272).

Poa Nevadensis, Vasey, Bull. Torr. Club, x, 66 (1883).

I am unable to say whether this is frequent or not. I notice it mentioned by others as a valuable forage grass. Specimens at hand only from Big Sandy, July, 1892.

Poa occidentalis, Vasey.

This fine species is common on the streams near Laramie; Fish Hatchery, July, 1891; Laramie River, June 22, 1895 (No. 1317).

Poa pratensis, L. Sp. Pl. 67 (1753).

Collected in 1892 for the World's Fair exhibit; common. *Blue Grass.*

Poa reflexa, Vasey & Scribn.

An alpine or subalpine species.

Bald Mountain, August 16, 1892; La Plata Mines, August 24, 1895 (No. 1837).

Poa rupestris, Vasey.

Rare; noted but once at 11,000 ft.; La Plata Mines, August 23, 1895 (No. 1813).

Poa serotina, Ehrh. Beitr. vi, 83 (1793). *Poa flava*, L.

Cheyenne, August 11, 1891. *False Red Top.*

Poa tenuifolia, Nutt. Buckley, Proc. Acad. Phila. 1862, 96 (1862).

Very common throughout the state.

Big Sandy, July, 1892; Laramie Hills, May 23, 1894 (No. 49). *Bunch Grass.*

Poa Vaseyana, Scribn.

This fine species was found in abundance by Prof. Buffum, on the Big Sandy, July 1892. He sent it for determination to Dr. Beal, who pronounced it probably new. Whether specimens were later sent to the Department of Agriculture or the same had been collected by Dr. Vasey I am unable to say, but subsequently it received the above name.

Poa sp.

Of this, Dr. F. Lamson-Scribner writes: "I am not prepared to name it. It has some characters in common with *Poa occidentalis*, Vasey, but it is apparently distinct from that."

Glyceria arundinacea, Kunth.

On Spring Creek, Big Horn Mountains, August 5, 1892.

Glyceria grandis, Wats, Gray, Man. Ed. 6, 667 (1890). ***Panicularia** aquatica,* (L.) Kuntze.

Common in partially submerged meadow lands.

Big Horn Valley, July, 1892; Cummins, July 30, 1895 (No. **1534**).

Glyceria pauciflora, Presl. Rel. Hænk. i, 257 (1830). ***Panicularia** pauciflora,* (Presl.) Kuntze.

Infrequent; Centennial Valley, August 18, 1895 (No. 1720).

Festuca confinis, Vasey.

Big Horn Mountains, August, 1892; Carbon county, June 11, 1892; Pole Creek June 2, 1894 (No. 161); Wallace Creek, July 29, 1894 (No. 667).

Festuca gracillima, Hook.

Big Sandy, Wind River Mountains, July, 1892.

Festuca ovina, L. Sp. Pl. 73 (1753).

From Laramie county, August, 1891.

Festuca ovina brevifolia, Chlor. Melv. 289 (1823).

Big Sandy, July, 1892.

Festuca rubra, L. Sp. Pl. 74 (1753).

Wind River Mountains, July, 1892.

Festuca tenella, Willd. Enum i, 113 (1809). *F. octoflora,* Walt. Fl. Car. 81.

Wheatland, 1892, by M. R. Johnson.

Bromus breviaristatus, (Hook.) Buckl. Proc. Acad. Phila. 1862, 98 (1862).

Wolf Creek, July, 1892.

Bromus ciliatus, L. Sp. Pl. 76 (1753).

Inyan Kara Divide, August 30, 1892.

Bromus Hookerianus, Thurb.

Centennial Valley, September 7, 1891.

Bromus Kalmii occidentalis, Vasey.

Union Pass, August 11, 1894 (No. 821); Sand Creek, Fremont County, August 27, 1894 (No. 1105).

Bromus Pumpellianus, Scribn.

Big Wind River, July 1892.

Agropyrum caninum, R. & S. Syst. ii, 756 (1817).

Specimens in the World's Fair collection, 1892.

Agropyrum divergens, Nees. Steud. Syn. Gram. 347 (1855).

Frequent in the northern part of the state.

Lander, July 1892; Union Pass, August 11, 1894 (No. 820).

Agropyrum glaucum, R. & S. Syst. Veg. ii, 752 (1817). *A. repens glaucum,* (Desf.) Scribn.

One of the most valuable of the native hay grasses, producing heavy crops under judicious irrigation. It is essentially an upland grass and over-irrigation will soon destroy it.

Lander, July 1892; Laramie and other places at various times.

Agropyrum unilaterale, Cassidy, Bull. Col. Exp. Station xii, 63 (1890) *A. caninum unilaterale* (Cassidy) Vasey.

Sheridan, August 18, 1892.

Agropyrum violaceum, Vasey, Grasses U. S. Spec. Rep. No. 63, 45.

A valuable forage plant; Big Sandy, July 1892.

Hordeum jubatum, L. Sp. Pl. 85 (1753).

The worst weed in the state; a positive pest in the hay fields. Its extermination should receive every encouragement.

Hartville, July 16, 1894 (No. 558), and noted in numerous places.

Hordeum nodosum, L. Sp. Pl. Ed. 2, 126 (1762).

Infrequent; Big Horn Mountains, August 4, 1892.

Hordeum pusillum, Nutt. Gen. i, 87 (1818).

Infrequent; Platte River, Fairbanks, July 11, 1894 (No. 426).

Elymus Canadensis, L. Sp. Pl. 83 (1753).

Frequent but hardly common; Whalen Canon, July 18, 1894 (No. 552), and by B. C. Buffum in 1892.

Elymus condensatus, Presl. Rel. Hænk. i, 265 (1830).

Common along streams in the eastern part of the state

Wheatland, 1892.

Elymus sitanion, Schult. Mant. ii, 426 (1824). *E. elymoides,* (Raf.) Swezey.

On mountain slopes at high altitudes.

Union Peak, August 13, 1894 (No. 1021); Laramie Peak, August 6, 1895 (No. 1602).

Elymus Virginicus, L. Sp. Pl. 84 (1753).

Not common; Prairie Dog, August 8, 1892.

CONIFERÆ.

Pinus flexilis, James, Long Exp. ii, 35 (1823).

This is common in our mountain ranges.

Laramie Hills, May 12, 1894 (No. 18); Cummins, July 29, 1895 (No. 1501). *Rocky Mountain White Pine.*

Pinus Murrayana, Balfour, Jeffr. Rep. Oreg. Exp. (1853).

Noted in the foothills in the Laramie and Medicine Bow ranges, where it is of frequent occurrence along streams.

Our specimens from Pole Creek, May 12, 1894 (No. 12); May 18, 1895 (No. 1213). *Lodge Pole Pine.*

Pinus ponderosa scopulorum, Engelm. Wats. Bot. Cal. ii, 126 (1880).

This forms a somewhat scattering growth on the higher more exposed ridges in the Laramie range, and less conspicuously so in the other ranges visited.

Laramie Hills, May 12, 1894 (No. 17). *Rocky Mountain Yellow Pine.*

Picea Engelmanni, Engelm.

This forms a considerable proportion of the forest growth in the Medicine Bow and probably in the other ranges of our state. Attaining its most luxuriant growth at about 9,000 ft., it is the sole survivor of the trees at timber line and there becomes reduced and spreading-prostrate. Said to be the most valuable of our trees for lumber.

Union Pass, August 13, 1894 (No. 1014); La Plata Mines, August 24, 1895 (No. 1841). *Engelmann's Spruce.*

Picea pungens, Engelm.

This is much less common and usually occurs along streams in the wooded foothills. It is considered the most beautiful of our Spruces and is well worthy of the high esteem in which it is held as an ornamental tree.

Laramie Hills, May 12, 1894 (No. 16); Cummins, July 30, 1895 (No. 1549). *Blue Spruce. Balsam.*

Pseudotsuga Douglasii, Carr.

The largest of our forest trees, attaining a remarkable size in the lower altitudes of our mountain ranges.

Laramie Hills, May 12, 1894 (No. 14); April 1895 (No. 1208); *Douglas Spruce.*

Juniperus communis, L Sp. Pl. 1040 (1753).

Very rare; Cummins, July 28, 1895 (No. 1481).

Juniperus communis alpina, Gaud. Fl. Helv. vi, 301 (1830). *J. nana*, Willd.

This is abundant on hillsides at all altitudes.

Laramie Hills, May 4, 1894 (No. 11); Little Sandy, August 30, 1894 (No. 1128). *Prickly Juniper.*

Juniperus Sabina procúmbens, Pursh, Fl. Am. Sept. 647 (1814). *J. Sabina,* L.

Rare; observed only on the alpine summits of the Medicine Bow Mountains, La Plata, August 24, 1895 (No. 1834).

Juniperus Virginiana, L. Sp. Pl. 1039 (1753).

This is frequent, varying within our range from a prostrate, scraggly shrub to a large tree. Incorrectly called *Red Cedar.*

Laramie Hills, April 4, 1894 (No. 1). *Virginia Juniper.*

EQUISETACEÆ.

Equisetum arvense, L. Sp. Pl. 1061 (1753).

Frequent on water courses.

Pole Creek, May 25, 1894 (No. 77); July 2, 1895 (No 1411).

Equisetum arvense alpestre, Wahl.

Not common; occurring usually on abrupt wet creek banks.

Big Wind River, August 5, 1894 (No. 706).

Equisetum hiemale, L. Sp. Pl. 1062 (1753).

Common on sandy river bottoms.

Laramie River, June 19, 1894 (No. 275); Laramie Peak, August 8, 1895 (No. 1640). *Scouring Rush.*

Equisetum lævigatum, A. Br. Engelm. Am. Journ Sci. xlvi, 87 (1844).

Infrequent; C. Y. Ranch on the Big Muddy, July 23, 1894 (No. 604)

Equisetum variegatum, Schleich. Cat. Pl. Helv. 27 (1807).

Fish Hatchery at Laramie, July 1891; Pole Creek, June 28, 1895 (No. 1355).

FILICES.

Asplenium Filix-fœmina, (L.) Bernh. Schrad. Neues. Journ. Bot. i, part 2, 26 (1806).

Infrequent; Jackson's Hole, August 21, 1894 (No. 940).

Cheilanthes lanuginosa, Nutt. Hook. Sp. Fil. ii, 99 (1858). *C. gracilis,* Mett.

In dry, rocky, cliffs; Laramie, 1891; Platte Canon, July 13, 1894 (No. 442).

Chryptogramma acrostichoides, R. Br. App. Frank. Journ. 767 (1823).

Teton Mountains, August 21, 1894 (No. 950).

Cystopteris fragilis, (L.) Bernh. Schrad. Neues. Journ. Bot. i, part 2, 27 (1806).

Common; Pole Creek, June 2, 1894 (No. 97); Mexican Mines, July 20, 1894 (No. 587).

Notholæna sinuata, Kaulf.

A specimen by B. C. Buffum, July 8, 1892; no other data.

Pteris aquilina, L. Sp. Pl. 1075 (1753).

Teton Mountains, August 21, 1894; Laramie Peak, August 6, 1895 (No. 1601).

Woodsia Oregana, Eaton, Can. Nat. ii, 90 (1865).

Centennial Hills, August 16, 1895 (No. 1682).

Woodsia scopulina, Eaton, l. c.

Much more frequent than the preceding; in crevices and on rocky ledges throughout our range.

Teton Mountains, August 21, 1894 (No. 951); Laramie Peak, August 6, 1895 (No. 1594).

SELAGINELLACEÆ.

Selaginella rupestris, Spring, in Mart. Fl. Bras. i, part 2, 118 (1840).

On a dry, naked ridge near table Mountain, June 28, 1895 (No. 1345).

MUSCI.*

Ceratodon purpureus, Brid. Bryol. Univ. i, 480 (1826).

Head of Pole Creek, May 18, 1895 (No. 1211 in part).

Desmatodon latifolius glacialis, Schimp. Syn. 157.

Nearly alpine; La Plata Mines, August 24, 1895 (No. 1835).

Desmatodon Porteri, James, Aust. Musc. Appal. n. 123.

Cummins, July 30, 1895 (No. 1538 in part).

Barbula mucronifolia, Bruch. & Schimp. Mon. xxxviii, t. 23 (1842).

Cummins July 30, 1895 (No. 1538 in part).

Philonotis fontana, Brid. Bryol. Univ. ii, 18 (1827).

Centennial Valley, August 18, 1895 (No. 1756); LaPlata Mines, August 22, 1895 (No. 1800).

Aulacomnium papillosum, Lesq. & James, Man. Moss. N. A. 253.

Centennial Valley, August 19, 1895 (No. 1746).

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* The Musci were determined and arranged by Prof. J. M. Holzinger.

Leptobryum pyriforme, Schimp. Syn. Musc. Eur. 390 (1876).
Centennial Valley, August 18, 1895 (No. 1717).

Webera albicans, Schimp. Coroll. 67.
Pole Creek, near Table Mountain, July 1, 1895 (No. 1285).

Webera elongata, Schwægr. Spec. Musc. 48.
Centennial Valley; August 18, 1895 (No. 1723 in part).

Webera sp.
Specimens sterile, but different from the preceding.
Centennial Valley, August 19, 1895 (No. 1745).

Bryum cæspiticium, L. Sp. Pl. ii, 1121 (1753).
Head of Pole Creek, May 18, 1895 (No. 1211 in part).

Bryum cirrhatum, Hoppe & Hornsch. Fl. 90 (1819). var. ?
Cummins, July 30, 1895 (No. 1538 in part).

Bryum intermedium, Brid. Musc. Recent Suppl. iv, 120.
Centennial Valley, June 8, 1895 (No. 1263).

Bryum pseudotriquetrum, Schwægr. Suppl. i, 2, 110.
Centennial Valley, June 8, 1895 (No. 1259).

Mnium subglobosum, Bruch. & Schimp. Bryol. Eur. t, 388.
Centennial Valley, August 19, 1895 (No. 1744).

Timmia Austriaca, Hedw. Sp. Musc. 176, t. 42 (1801).
Laramie Peak, August 8, 1895 (No. 1645).

Polytrichum juniperinum alpinum, Schimp. Syn. 447.
La Plata Mines, August 24, 1895 (No. 1830).

Polytrichum piliferum, Schreb. Spicil. Fl. Lips. 74.
La Plata mines, August 21, 1895 (No. 1769).

Climacium Americanum, Brid. Musc. Recent Suppl. ii, 45.
Centennial Valley, August 19, 1895 (No. 1724).

Pseudoleskea oliogoclada, Vindb.
Centennial Valley, August 18, 1895 (No. 1734).

Thuidium Blandovii, Bruch. & Schimp. Bryol. Eur. t. 486.
Centennial Valley, August 19, 1895 (No. 1746 in part).

Brachythecium acutum, Sulliv. Icon Musc. Suppl. 99, t. 75.
Centennial Valley, August 17, 1895 (No. 1698).

Brachythecium rivulare, Bruch & Schimp. Bryol. Eur. t. 543.
Laramie Peak, August 7, 1895 (No. 1622).

Hypnum commutatum, Hedw. Musc. Frond. iv, 68, t. 24.
Gros Ventre River, August 16, 1894 (No. 1088).

Hypnum plicatile, Lesq. & James. Man. Moss. N. A. 394.
Cummins, July 29, 1895 (No. 1507).

MARCHANTIACEÆ.

Marchantia polymorpha, L.
Frequent on wet banks; Green River, August 25, 1894 (No. 1005). Centennial Valley, August 18, 1895 (No. 1748).

ALGÆ.

The Algæ have received no attention so far as specific determination is concerned. In the collection of material for class use in the laboratory it has been found that quite a large number of genera are represented, some of them by a number of species. Among these *Spirogyra*, *Zygnema* and *Vaucheria* may be named. *Diatomaceæ* are everywhere but the *Desmidiaceæ* are not so well represented.

Among the larger forms the two following are conspicuous in the ponds at the city springs:

Chara fœtida, A. Br.
It forms a dense growth over the bottom of the ponds, in places reaching a foot or more in height.

Batrachospermum gelatinosum, (L.) A. F. Woods, Rep. Bot. Surv. Neb. iii, 6 (1894).
Adherent to stones in running water.

Chara sp.
A rather unusual *Chara* was collected in a pool in the mouth of an extinct geyser pan on Warm Spring Creek. It is in the hands of Mr. J. W. Blankinship for determination; August 9, 1894 (No. 796).

FUNGI.

The following Fungi have been determined by Mr. J. B. Ellis. They include only incidental "pickups" in the field. Those of economic importance that we have had to deal with on the Experiment Farm are not included.

Æcidium abundans, Pk.
Cummins, July 29, 1895 (No. 1498). On *Symphoricarpos eriophilus.*

Æcidium monoicum, Pk.

Laramie Hills, May 23, 1894 (No. 50). On *Sisymbrium linifolium.*

Æcidium Œnothera, Mont.

Pole Creek, June 2, 1894 (No. 133). On *Œnothera brachycarpa.*

Uromyces Junci, (Schw.) Tul.

Laramie, December, 1895 (No. 1207). On *Juncus sp.*

Erysiphe cichoracearum, DC.

Cummins, July 29, 1895 (No. 1516). On *Hydrophyllum occidentale.*

Melampsora farinosa, (Pers) Schrœt.

Cummins, July 29, 1895 (No. 1520); Centennial Valley, August 25, 1895 (No. 1864). Frequent on various *Willows.*

Phragmidium subcorticum, Schrank.

Cummins July 29, 1895 (No. 1499). On *Rosa blanda* (?).

Ramularia sidalcea, E. & E.

Cummins, July 29, 1895 (No. 1468). On *Sidalcea candida.* Mr. Ellis writes of this as follows; "I have seen it but once before. It was from British Columbia, sent by Dr. Macoun."

LICHENES.

The following are a few of our commoner *Lichens*:

Claydonia pyxidata, Fr. Centennial Valley, August 18, 1895 (No. 1749).

Evernia vulpina, Ack. Centennial Hills, August 17, 1895 (No. 1699).

Parmelia conspersa, Ehrh. Pole Creek, July 1, 1895 (No. 1387).

Parmelia molliuscula, Ack. Laramie, July 23, 1895 (No. 1429).

Peltigera aphthosa, Hoffm. Laramie Peak, August 8, 1895 (No. 1644).

Peltigera canina, Hoffm. Cummins, July 29, 1895 (No. 1508).

Rinodina turfacea, Kœrb. Centennial Hills, August 17, 1895 (No. 1713).

Appendix to List of Species.

***Arabis Drummondii,** Gray, Proc. Am. Acad. vi, 187.

On fertile hillsides in the mountains; not frequent.

Union Pass, August 10, 1894 (No. 875); Centennial Hills, June 7, 1895 (No. 1248).

Arabis hirsuta, (L.) Scop. Fl. Carn. Ed. 2, ii, 30 (1772),

In sandy valleys, sometimes among the sage brush; frequent.

Laramie Hills, June 7, 1894 (No. 181); Union Pass, August 13, 1894 (No. 1074); Pole Creek, July 1, 1895 (No. 1394).

Arabis Holbœllii, Hornem. Fl. Dan. t. 1879 (1827).

On a dry, stony sandbar of the Laramie River, Cummins, July 30, 1895 (No. 1551).

Arabis Holbœllii Fendleri, Wats. Syn. Fl. i, 164 (1895).

Noted only in the sand beds of the stony foothills of the Laramie range; May 16, 1894 (No. 32).

Arabis Lemmoni, Wats. Proc. Am. Acad. xxii, 467 (1887).

Among the sage brush on the plains; infrequent.

Laramie, May, 23, 1894 (No. 56).

Arabis Lyalli, Watson, Proc. Am. Acad. xi, 122.

Alpine; Teton Mountains, August 21, 1894 (No. 1007).

Arabis Nuttallii, Robinson, Syn. Fl. i, 160 (1895).

In valleys but on dry ground.

Horse Creek, June 9, 1894 (No. 218); Pole Creek, June 28, 1895 (No. 1359).

Arabis perfoliata, Lam. Encycl. i, 219 (1788).

Rare; noted but once; Laramie Peak, August 7, 1895 (No. 1628).

Thelypodium integrifolium, Endl. in Walp. Rep. i, 172 (1842).

Very frequent, especially on saline plains.

Lusk, July 21, 1894 (No. 574); Dubois, August 9, 1894 (No. 747); Laramie, August 10, 1895 (No. 1663).

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* Determinations in this genus by Dr. B. L. Robinson.

Thelypodium sagittatum, Endl. l. c.

Widely distributed, but only scattering plants.

Wheatland, June 18, 1891 ; Pole Creek, June 2, 1894 (No. 112); Bacon Creek, August 15, 1894 (No. 922).

Sisymbrium virgatum, Nutt. in T. & G. Fl. i, 93.

On sandy ground among the sage brush.

Laramie Plains, June 9, 1895 (No. 1299).

Draba nemorosa, L. Sp. Pl. 643 (1753).

Frequent in wet loam soil in valleys ; variable, some of our specimens are the variety *hebecarpa*, Lindb.

Pole Creek, June 2, 1894 (No. 153); Union Pass, August 11, 1894 (No. 854); Centennial Valley, June 9, 1895 (No. 1254); at other times and places.

Arenaria Nuttallii, Pax in Engler, Jahresb. xviii, 30.

Infrequent ; noted only at Garfield Peak, July 29, 1894 (No. 675).

Astragalus bodini, Sheld.

Very abundant in meadow lands in the Centennial Valley ; August 25, 1895 (No. 1855).

Astragalus leucopis, Torr. Mex. Bound. Surv. 56, t. 16.

Rare ; specimens from the eastern part of the state by B. C. Buffum in 1892.

Astragalus Parryi, Gray, Am. Journ. Sci. ii, 33.

Freqnent on gravelly hillsides ; Pole Creek, June 2, 1894 (No. 101); Centennial Valley, June 9, 1895 (No. 1298).

CORRECTIONS:—

On page 63, line 3 from bottom, read Engelmann's Spruce for Douglas Spruce.

In the *Astragali* some of the names as given in the list of *Pteridophyta* and *Spermaphyta*, which it was intended to give as synonyms, were inadvertently omitted.

New Species and Varieties.

The succeeding list includes the new species, varieties and names as published in this report.

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Eriogonum subalpinum, Greene, Pitt. iii, part 13, 18 (1896)	174

Lists of Plants Reported by Other Collectors.

In the succeeding lists such plants are given as have been reported by others from this state but are as yet unrepresented in our herbarium. It is intended to exclude all names that are merely synonyms of those of our own list, but even with greatest care I fear some will get in. Some, while not synonyms, are names of plants that very doubtfully belong to this region at all. On the other hand these lists, undoubtedly, do not represent all that have been reported from this state, but are intended to be complete with respect to the literature at hand. Such references as could not somewhat satisfactorily be verified are excluded, probably too many.

FROM TORREY'S REPORT ON THE PLANTS OF FREMONT'S EXPEDITION, 1842.

Astragalus tridactylicus, Gray, as *Phaca digitata*, Torr. Little Sandy, August 8.

Potentilla Pennsylvanica glabrata, Watson, as *P. sericea glabrata*, Lehm. Sweetwater River, August 4-15.

Sedum rhodiola, DC. Wind River Mountains, August 12-17.

Symphoricarpos vulgaris, Michx. Wind River Mountains, August 13-14.

Aster Novæ-Angliæ, L. Wind River Mountains, August 18.

Aster andinus, Nutt. Wind River Mountains, August 16.

Erigeron salsuginosus glacialis, Gray, as *Aster glacialis*, Nutt. Wind River Mountains, August 16.

Solidago nemoralis incana, Gray, as *S. incana*, T. & G. Sweetwater River.

Helianthus petiolaris, Nutt. Laramie Hills, July 26.

Helianthus Maximiliana, Schrader. Laramie Hills, July 26.

Hymenopappus corymbosus, T. & G. Upper Platte, August 26.

Vaccinum myrtilloides, Hook. Wind River Mountains, August 15.

Dodecatheon Meadia latilobum, Gray, as *D. dentatum*, Hook., Wind River Mountains, August 13-16.

Phlox muscoides, Nutt. Wind River Mountains, August 15.

Gentiana arctophila, Griseb. Sweetwater River, August 4.

Gentiana linearis, Frœl. as *G. pneumonanthe*, L. Laramie River, July 12.

Habenaria leucophæa, Gray, as *Plantanthera leucophæa*, Lindl. Laramie (Black) Hills, July 27.
Spiranthes cernua, Rich. Sweetwater River, August 6.

FROM COULTER'S REPORT ON THE BOTANY OF THE HAYDEN SURVEY, 1872.

Clematis alpina occidentalis, Gray, Teton Mountains, July.
Ranunculus Nelsonii, Gray, Yellowstone Lake.
Aquilegia flavescens, Wats. Yellowstone Lake, August.
Delphinium Menziesii, DC. Teton Mountains, July.
Aconitum Fischeri, Wats. as *A. nasutum*, Hook. Yellowstone Lake, August.
Nuphar advena, Ait. Yellowstone Park, August.
Dicentra uniflora, Kellogg. Teton Mountains, August.
Cardamine oligosperma, Nutt. Teton Mountains, July.
Draba aurea, Vahl. Teton Mountains, July.
Draba nivalis, Lilj. as *D. Stellata*, Jacq. Teton Mountains, July.
Lychnis Drummondii, Wats. Yellowstone Park, July.
Arenaria pungens, Nutt. Teton Mountains, July.
Arenaria verna, L. Teton Mountains, July.
Arenaria laterifolia, L. Teton Mountains, July.
Sagina Linnæi, Presl. Yellowstone Park, August.
Claytonia linearis, Hook. Clark's Fork, August.
Spraguea umbellata, Torr. Yellowstone Park, August.
Dryas octopetala, L. Teton Mountains, July.
Ivesia Gordoni, Gray, Teton Mountains, July.
Saxifraga oppositifolia, L. Teton Mountains, July.
Tellima parviflora, Hook. Teton Canon, Wyo. (?), July.
Heuchera cylindrica, Dougl. Yellowstone Park, August.
Ribes bracteosum. Dougl. Teton Canon, Wyo. (?) August.
Sedum rhodiola, DC. Teton Mountains, July.
Linnæa borealis, Gronov. Yellowstone Park, August.
Townsendia scapigera Eaton, Teton Mountains, July (?).
Solidago serotina, Ait. as *S. gigantea*, Ait. Yellowstone Park, August (?).
Rudbeckia occidentalis, Nutt. Teton Mountains, July.
Crepis Andersoni, Gray, Yellowstone Park, August.
Crepis nana, Richards, Teton Mountains, July.

Vaccinum ovafolium, Smith, Upper Teton Canon, July.
Ledum glandulosum, Nutt. Shoshone Lake, September.
Pentstemon Menziesii, Hook. Teton Mountains, August (?).
Mimulus nanus, H. & A. as *Eunanus Fremonti*, Gray, Crater Hills, August.
Synthyris alpina, Gray, Teton Mountains, July.
Orthocarpus Tolmiei, H & A. Fort Bridger, by Dr. Leidy.
Lycopus Virginicus, L. Yellowstone Park, August.
Hydrophyllum capitatum alpinum, Wats. Teton Mountains, July.
Nemophila parviflora, Dougl. Yellowstone, July.
Phlox canescens, T. & G. Teton Mountains, July.
Gilia intertexta, Steud. Teton Mountains, August.
Polemonium foliossimum, Gray, Yellowstone Lake, August.
Kochia prostrata, Shrad. Fort Bridger, by Dr. Leidy.
Erigonum salsuginosum, Hook. Fort Bridger, by Dr. Leidy.
Salix reticulata, L. Teton Mountains, July.
Pinus contorta Dougl. Yellowstone Park, August.
Abies Subalpina, Eng. as *A. grandis*, Trail River Mountains, August.
Lemma triscula, L. Yellowstone Park, August
Zannichellia palustris, L. Yellowstone Lake, 1871.
Goodyera Menziesii, Lindl. Teton Mountains, September.
Corallorhiza mutiflora, Nutt. Shoshone Lake, September.
Lloydia serotina, Reich. Teton Mountains and Clark's Fork, July.
Carex rigida, Good. Red Mountain, September.
Carex alpina, Swartz. Uinta Mountains, by Dr. Leidy.
Calamagrostis sylvatica, DC. Teton Mountains. August.
Spartina gracilis, Trin. Yellowstone Park, August.
Pellæa Breweri, Eaton Teton range, August.
Pellæa densa, Hook. Jackson's Lake, September.
Aspidium Lonchitis, Swartz. Teton Mountains, July.
Aspidium spinulosum, Swartz. Teton Mountains, September.

FROM PARRY'S REPORT ON THE BOTANY OF JONES'S EXPEDITION IN NORTHWESTERN WYOMING, 1873.

Aquilegia flavescens, Wats. Yellowstone Park, August.
Aquilegia Jonesii, Parry, Owl Creek range, July.
Delphinium Menziesii, DC. Fort Bridger, June.

Ranunculus occidentalis, Nutt. Little Sandy, June.
Myosurus minimus, L. Snake River, September.
Thalictrum alpinum, L. Wind River range, July.
Stanleya tomentosa, Parry, Owl Creek, July.
Draba ventosa, Snake River Pass, September.
Arabis canescens, Nutt. Sweetwater, June.
Lesquerella (*Vesicaria*) alpina, Nutt. Green River, June.
Capsella divaricata, Walp. Little Sandy, June.
Nasturtium curvisiliqua lyratum, Wats. Yellowstone, August.
Subularia aquatica, Yellowstone Lake, August.
Arenaria Franklinii, Dougl. Wind River, July.
Arenaria pungens, Nutt. Stinkingwater, July.
Arenaria stricta, Wats as *A. Rossii*, R. Br. Owl Creek range, July.
Arenaria arctica, Stev. Owl Creek, July.
Lychnis Drummondii, Wats. Owl Creek, July.
Lychnis Kingii, Wats. as *L. Ajanensis*, Regel. Owl Creek range, July.
Spraguea umbellata, Torr. Stinkingwater, August.
Calyptridium roseum, Wats. Green River, June.
Rhamnus alnifolia, L'Her. Stinkingwater, August.
Lupinus minimus, Dougl. Stinkingwater, August.
Trifolium andinum, Nutt. Ham's Fork, June.
Astragalus ventorum, Grey, Wind River, July.
Astragalus triphyllus, Pursh, Owl Creek, July.
Astragalus simplicifolius, Gray, Green River, June.
Astragalus glabriusculus, Gray, Wind River, July.
Astragalus lotiflorus, Hook. Wind River, July.
Astragalus Geyeri, Gray, Green River, June.
Astragalus flavus, Nutt. Green River, June.
Astragalus pubentissimus, Nutt. Green River, June.
Astragalus glareosus, Dougl. Green River, June.
Astragalus microcystis, Gray, Stinkingwater, July.
Oxytropis campestris, L. Owl Creek, July.
Oxytropis viscida, Nutt. Wind River, July.
Oxytropis lagopus, Nutt. Pacific Springs, June.
Spirea cæspitosa, Nutt. Owl Creek range, July.
Ivesia Gordoni, Gray, Stinkingwater, July.
Heuchera cylindrica Dougl. Stinkingwater, July.
Saxifraga debilis, Engelm. Owl Creek range, July.

Ribes viscosisimum, Pursh, Yellowstone, August.
Ribes bracteosum, Dougl. Wind River, July.
Œnothera andina, Nutt. Green River, June.
Œnothera scapoidea, Nutt. Green River, June.
Zaushneria Californica, Pressl. Stinkingwater, July.
Peucedanum leiocarpum, Nutt. Yellowstone, August.
Cymopterus Fendleri, Gray, Green River, June.
Lonicera cærulea, L. Yellowstone, August.
Kellogia galeoides, Torr. Stinkingwater, August.
Erigeron coccinnus, Gray, Green River, June.
Townsendia spathulata, Nutt. Wind River, July.
Townsendia Watsoni, Gray, as *T. strigosa*, Nutt. Wind River, July.
Townsendia Parryi, Eaton. Wind River, July.
Townsendia condensata, Parry, Washakie's Needles, July.
Bahia (*Schkuhria*) integrifolia, Parry, Wind River Mountains, July.
Rudbeckia occidentalis, Nutt. Snake River, September.
Arnica Parryi, Gray, Yellowstone, August.
Aplopappus suffruticosus, Gray, Yellowstone, August.
Aplopappus multicaulis, Gray, Wind River, July.
Balsamorrhiza Hookeri, Nutt. Pacific Springs, June.
Antennaria dimorpha, Nutt. Green River, June.
Antennaria luzuloides, T. & G. Stinkingwater, July.
Tanacetum Nuttallii, T. & G. Wind River, July.
Artemisia pedatifida, Nutt. Green River, June.
Artemisia spinescens, Eaton, Green River, June.
Artemisia discolor incompta, Gray, Owl Creek, July.
Troximon glaucum parviflorum, Gray, Green River, June.
Stephanomeria paniculata, Nutt. Stinkingwater, July.
Crepis occidentalis, Nutt. Wind River, July.
Laurentia (Porterella) carnosula, Benth. Yellowstone, August.
Ledum glandulosum, Nutt. Yellowstone, August.
Gaultheria Myrsinites, Hook, Yellowstone, August.
Pyrola picta, Smith, as *P. dentata*, Hook. Yellowstone, August.
Androsace Chamæjasme, L. Owl Creek, July.
Douglasia montana, Gray, Owl Creek Mountains, July.
Pentstemon Menziesii, Hook, Stinkingwater, August.
Mimulus nanus. H. & A. as *Eunanus Fremontii*, Gray, Yellowstone, August.

Castilleia breviflora, Gray, Stinkingwater, July.
Gilia pungens, Benth. Green River, June.
Gilia iberidifolia, Benth. Green River September.
Asclepias brachystephana, Torr. Green River, June.
Polygonum imbricatum, Nutt. Stinkingwater, July.
Oxytheca dendroidea, Nutt. Big Sandy, June.
Atriplex endolepis, Watson, Stinkingwater, July.
Grayia polygaloides, H. & A. Green River, June.
Carex aquatilis, Wahl. Yellowstone, August.
Carex rigida, Good. Yellowstone, August.
Carex Hoodii, Boot. Wind River, July.
Carex tenuirostris, Olney, Yellowstone, July.
Isœtes Bolanderi, Engelm. Yellowstone, August.

FROM GRAY'S REPORT ON THE PLANTS OF THE JENNEY SURVEY OF THE BLACK HILLS, 1875.*

Clematis alpina occidentalis, Gray.
Thalictrum dioicum, L.
Aconitum Fischeri, Reichenb.
Lesquerella (*Vesicaria*) alpina, Nutt.
Viola delphinifolia, Nutt.
Helianthemum Canadense, Michx.
Polygala alba, Nutt.
Psoralea esculenta, Pursh.
Astragalus gracilis, Nutt.
Astragalus simplicifolius, Gray.
Lathyrus ochroleucus, Hook.
Sophora sericea, Nutt.
Geum rivale, L.
Rubus triflorus, Richard.
Œnothera pumila, L.
Thaspium trifoliatum, Gray.
Cymopterus glomeratus, Nutt.
Cornus Canadensis, L.
Aster falcatus, Lindl.
Solidago speciosa angustata, T. & G.
Echinacea angustifolia, DC.
Helianthus strumosus, L.
Helianthus petiolaris, Nutt.
Pentstemon grandiflorus, Nutt.
Pentstemon albidus, Nutt.
Verbena bipinnatifida, Nutt.
Lophanthus anisatus, Benth.
Mertensia oblongifolia (Nutt.) Don.
Eriogonum multiceps, Nees.
Lilium Philadelphicum, L.
Prosartes lanuginosa, Don.
Pellæa atropurpurea, Link.
Onoclea sensibilis, L.

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* Although the Black Hills are largely in Dakota, yet as the route of the party to and from them lay in this state, and as the flora of the Hills may reasonably be supposed to be approximately the same in both states, these names are included here.

SUMMARY.

In the foregoing lists there have been enumerated from the material in this herbarium 1118 species and varieties of *Phanerogams* (*Spermatophytes*), representing 393 genera. Omitting duplicates from the lists of plants reported by others there are enumerated 177 more, making a total of 1295 thus far reported from this state. This number, undoubtedly, does not do justice to all the work that has been done in the state and falls far short of the number that may be expected when it shall have been thoroughly worked. The northeast and southwest floras are quite distinct from each other and from those portions of the state which have been the most carefully examined. These are yet to be secured.

By way of comparison it may be stated that the following are among the best worked states and the number of species and varieties of *Phanerogams* reported are for Nebraska about 1460, and for West Virginia 1309.

Concerning the *Cryptogams* it may be said that they represent largely an unexplored field. Only 65 species are enumerated in this list, making the total number from this collection 1176 and for the state according to this list 1360. This does not include the Mosses and Lichens of the Hayden report, and possibly other collections may have been omitted.

Duplicates of a large part of the plants enumerated from this collection will be found in the herbaria of Harvard University, Columbia University, Shaw Botanic Garden, National Herbarium, the Vanderbilt collections at Biltmore, N. C., University of Minnesota, Cornell University, and Prof. E. L. Greene's Herbarium.

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UNIVERSITY OF WYOMING.

Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 31.

DECEMBER, 1896.

The Worst Weeds of Wyoming

. . . AND . . .

Suggested Weed Legislation.

BY THE BOTANIST.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

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Agricultural Experiment Station.

UNIVERSITY OF WYOMING.

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To the Citizens of Wyoming.

The Experiment Station exists in order that it may be of service to the people of this State in particular, and to the agricultural interests of all in a general way. To this end it is due the Station that it have the hearty co-operation of all whom it is intended to serve. Its highest usefulness will be attained so soon as the efforts of the station workers can be concentrated upon the problems which press most urgently for solution. This cannot be accomplished unless the constituency of the station will place themselves as individuals in communication with the workers of the station, from whom they would like help. Let the problems which confront you be freely communicated, and the station will help you solve them, devoting special time to it if it be a problem of general interest.

The botanist invites correspondence on all topics of economic interest concerning plants, such as the prevalence of important weeds, the best means of destroying them, the appearance in any locality of new ones, any unusual development of old ones, the diseases of any of the cultivated crops due to Fungi, or any questions of that character.

He will determine any plants sent for that purpose. Material sent for identification should be as complete as possible. If the plant be small, send the entire plant or several of them. These should, where possible, have leaves, flowers and fruit. Of larger plants send a part containing average leaves with flowers and fruit, if it can be had. Portions of diseased crop plants may also be sent for determination of the Fungus causing the disease. All such material can be sent fresh by mail if closely wrapped in newspapers, or can first be dried under pressure between thick pads of newspaper and then sent by mail between pieces of paper securely protected by heavy pieces of cardboard.

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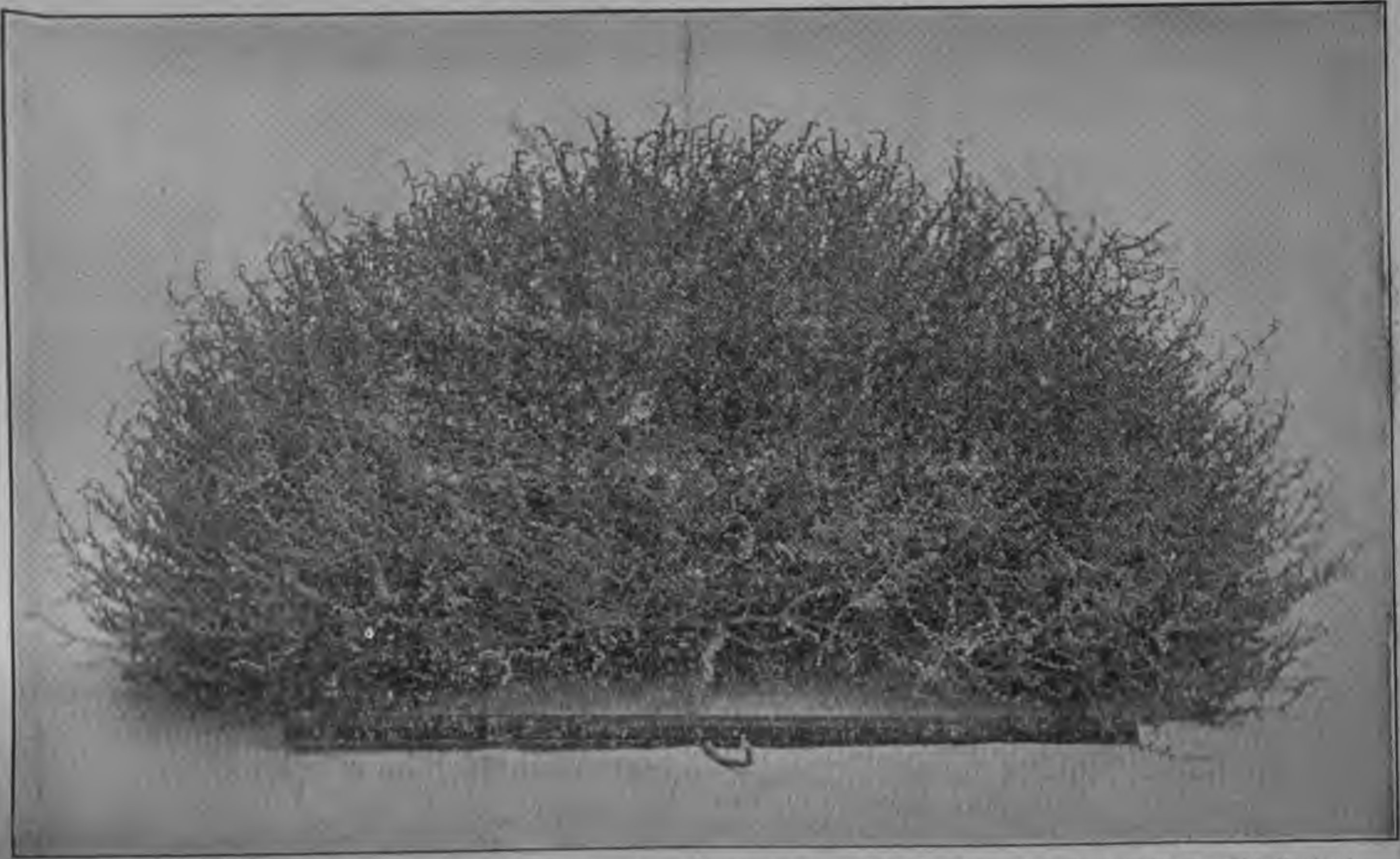

THE RUSSIAN THISTLE (*Salsola Kali Tragus* Moq.) Compact form, showing it as a well-developed *tumbleweed*. (Bulletin 55, Ohio Station.)

The Worst Weeds of Wyoming.

AVEN NELSON.

THE NATURE OF WEEDS.

As indicated in the title of this bulletin, it is not the intention of the writer to attempt at this time an exhaustive treatment of the subject of weeds. Its very nature is such as to preclude the hope of saying the final word on this subject. That this must be so is readily understood if we will call to mind what weeds are, and that the term *weed* is largely a relative one. The *weediness* of a plant depends in many cases upon the observer's point of view; that is, a plant is pronounced a weed, *bad* in proportion to the hindrance it offers to the production of that which is at that particular time and place the desirable, or *good.*

It has often been said that a *weed* is only a plant out of place, which may be accepted if we will add that it is one that *insists* on growing where it is not wanted.

It may be well to remember that there were no weeds anywhere till man appeared and found that certain plants could serve for him certain economic purposes. At first such plants as were from time to time found of use, were simply sought out from those places where they had succeeded in maintaining themselves in spite of the severe competition to which all plants in a state of nature are subjected. As these plants or their products became more and more desirable it dawned upon first one and then another to assist these desirable plants in their struggle for existence. This it was found could be done in two ways; by keeping down the other plants with which these were competing, or by removing the desirable ones into new localities where competition would be less severe.

When this point had been reached in man's struggle with nature, agriculture had its inception, and from that day to this some plants have been favored and others repressed by the hand of man.

On each of these two classes of plants this kind of treatment has produced its legitimate result. The undesirable class has grown more aggressive, holding its ground more stubbornly in each succeeding generation, developing but one quality, namely, that of maintaining and propagating itself under the most adverse circumstances. The desirable class, as it was more and more relieved from the necessity of striving for space, for food and for sunshine, developed its useful qualities to a greater degree, but on the other hand it became less and less fitted to struggle single handed, as it were, with its natural enemies.*

This dependence upon man has been and is still constantly being intensified by man's selective agency. For purposes of propagation those plants are selected which have shown a tendency to produce the desirable product in greater abundance or of more perfect quality, hence it has come about that nearly all plants of economic importance are man's wards, dependent upon him for their very existence, but rewarding him for his care by a superabundance of food materials, superior fibres for his various fabrics, and for his æsthetic sense a wealth of beauty surpassing an artist's dream.

---

*The oft used phrase, "Struggle for existence," given to us by Darwin, is used as he used it, in a large, metaphorical sense. Not even in the animal world is this struggle often an active combat, but it is none the less real and relentless. If one secures in a legitimate way, by reason of superior endowments, what a thousand need in order to maintain existence but only one can have, the struggle is just as actual, though it is an unconscious one, and the results to those that fail just as inglorious.

These, then, are the two classes of plants with which the tiller of the soil has to deal, one class representing all those that are at present known to be valuable to man; the other those which to a greater or less extent interfere with the most successful production of the first. To these last in a general way the term *weeds* is applied, but in its more restricted sense the term is applied to the larger or seed producing plants which come into direct competition with our cultivated plants by occupying or attempting to occupy our orchards, our gardens and our fields. Also, as previously suggested, the term has a significance relatively considered. The same plant may at different times be both a weed and a valuable plant. A volunteer crop of buckwheat in a cornfield is no less a weed than a thistle in a hayfield, hence plants cannot all be arbitrarily separated into *good* and *bad*, as the classification of some will depend upon the cultivator's point of view. For our present purposes, then, a weed may be defined as any plant which, by taking possession of the soil, reduces the quantity or quality of the desired crop, or becomes in any way an offense to the eye or an obstruction upon the lands in question.

THE EVOLUTION OF WEEDS.

Thousands of kinds of plants are found growing in greater or less abundance upon the earth. These all strive to perpetuate themselves, some in one way, some in another, but most of them produce seeds or spores which are intended to secure the continuity of the plant's life in that of new individuals successively produced. It can easily be shown that even the forms which produce the smallest number of seeds per plant, produce enough to cover the whole earth in a few years if each seed were allowed to germinate and develop. What, then, must be the condition when the thousands of kinds of plants, some of which literally produce tens of thousands of seeds, are striving to perpetuate themselves! How fierce must be the competition for place and food! As a result of this struggle for existence, some have adapted themselves to one condition and mode of life and some to another. In the life histories of the races which each represents we see intensified all those variations which have favored them in this fierce combat, not only with other forms, but even with those of their own kind. Those forms which have been able to adapt themselves to the most diverse conditions, to develop the most successful expedients for reproducing their kind and to most surely withstand adverse environments, are the plants which are now our *worst weeds*. These characteristics as displayed in the weeds of the following list will be considered in connection with each.

THE NOXIOUSNESS OF WEEDS.

All who have had any experience with weeds know only too well that some weeds are always an unmitigated nuisance and most of them a constant source of annoyance and financial loss. Few, however, realize to what extent the failure or partial failure to obtain remunerative results in their agricultural ventures is due to the weeds that run rampant in their fields and fence corners. The losses are always occasioned in several ways, among which may be mentioned the following: The weeds crowd out or shade out the less vigorous plants of the crop, thus reducing the number from which returns may be expected; they abstract from the soil such large quantities of plant food that the crop plants that do survive are not able to attain full development, and so yield inferior products that are unsalable or at best bring but small returns; they interfere with the most expeditious and economic methods of harvesting, and the harvested products, because of admixture with weeds or their seeds, sink still lower in market value; they may cause serious injury to stock, as in the case of Squirrel-tail Grass and some thistles; they may cause serious injury to such animal products as wool by reason of their hooked seeds clinging to and becoming involved in it as do all sorts of burs; the farm itself becomes less and less valuable, and the difficulty of disposing of it greater, for the intending purchaser sees the evidences of an impoverished soil well seeded to weeds. The fences to some extent concealed in the weeds on either side do not create a desire in any one to possess the enclosed acres. That sometimes some use can be made of some weeds does not prove that weeds are a good thing; it may be worth while to save a crop of Rag-weeds in times of scarcity, but it were better to grow something else.

THE PERMANENCY OF WEEDS.

Weeds, like the poor, we have always with us, and again like the poor, they are the most numerous in the most shiftless communities. As shiftlessness causes poverty and poverty induces shiftlessness, so shiftlessness endures weeds and weeds cause poverty now just as they did in the time Solomon. It is possible now as then to go by the field of the slothful and see it all overgrown with thorns and thistles, with the usual accompaniment of the broken down wall,—all evidences of a little more sleep and a little more folding of the hands. Now, as then, poverty comes to such a place as one that travelleth, and want as an armed man ; but do we, as Solomon, look upon it and receive instruction?

CLASSES OF WEEDS.

With reference to their natural period of life, weeds are spoken of as (1) Annuals, (2) Biennials and (3) Perennials.

The first are reproduced from seed each year, and are easily destroyed, as a rule, by uprooting, and will be eradicated if all the plants springing from a given crop of seed are destroyed. It is well to remember, however, that all the seeds do not germinate the first season. In many cases it is in the nature of the seeds for a part to grow the first and the rest the second year or even later. If the conditions are unfavorable, as lack of moisture or being buried too deeply, they may lie dormant for several years and then spring up, much to the wonder of the farmer as to their origin.

The second live two years, storing up food in the tissues during the first season in order that seed in superabundance may be rapidly produced during the second. These yield to the same methods of extermination as the first.

The third, living for a number of years, are, as a class, the most troublesome. Such perennials as are classed as weeds do not depend upon seeds alone for their propagation. They are provided with underground stems, known according to their structure and form, as rootstocks, bulbs, corms or tubers. These have the power of giving rise to new plants ; and separation from the parent plant, or even dismemberment of these underground stems, only serves to facilitate the production of new individuals. To this class belong those which most stubbornly resist eradication, as for example the Canada Thistle and Quack or Couch Grass. Many of our worst weeds, however, belong to the other classes, not because the individual plants are hard to kill, but either because of the vast number of seeds produced or the remarkable contrivances for securing their wide dispersal.

For convenience weeds may again be divided into two classes, viz: 1, *Cosmopolitan*, and 2, *Local*. In the first class we will place those which, on account of some remarkable power of propagation or some extraordinary vitality, are at home anywhere and are therefore peculiarly difficult to eradicate. These often require concerted action on the part of communities or states to secure their extirpation and thus avert the loss and annoyance which their complete establishment would entail. In this class we find our worst weeds, but it is to be remembered that such a term can be only a relative one. The worst weeds of one community are not necessarily those of another, for differences in soil, in climate and in character of crops will determine which are most to be feared. In the second class are all other weeds which yield to the ordinary means, viz: cultivation of the ground; in fact, they are rarely found outside of cultivated ground, and if so found are of no particular detriment. This class may very properly be left to individual concern, for the thrifty husbandman will see to it that his crops do not suffer on account of them, and the careless will have to be left to his own folly so long as he does not by his neglect inflict injury upon others.

PURPOSE OF THE BULLETIN.

I do not cherish the Utopian dream that we shall ever be rid of weeds, but there are some kinds that ought to receive the most earnest attention, not only on the part of individuals immediately concerned, but by the State as a whole. It is the purpose of this bulletin to call attention to such, to assist in making them known, to point out the dangers to be feared from each, to help in solving the difficult problems connected with their eradication, and to suggest some needed legislation looking to this end.

In order to secure community of action in this matter it is necessary that the worst pests shall be known and recognized by all. To this end a few of those which, in the judgment of the writer, are at present most to be feared are illustrated and briefly described. As the only object in view is ready recognition of the plant, non-technical language is used, reliance being placed upon the illustrations for enforcing the descriptions. It would be an easy matter to run up a list of a hundred or more weedy plants, but it seems wiser to direct attention to a few very aggressive ones that are weeds first, last, and all the time.

RUSSIAN THISTLE,

(*Salsola Kali Tragus* (L.) Moq.)

As it is intended to consider the weeds of this list in the order of the danger they present to our agricultural interests, the Russian Thistle is placed first, for the danger it threatens is both real and imminent. It has already inflicted untold injury upon the farmers of some of our neighboring States, viz: Nebraska, Iowa, Minnesota and the Dakotas. Several other States are suffering more or less, but having grappled sooner with the problems of its repression, much has been done in some of them to prevent its securing a foothold. In all of them active measures have been taken, which are doing much to restrict it, even in the worst infected States.

Wyoming cannot afford to delay in this matter; the pest is well established within our borders, and will, in another season or two, be entirely beyond our control. Our climatic and soil conditions are just such as to make this the ideal home of this dangerous tumbleweed.

HISTORY OF THE PLANT.*

The plant seems to be native on the plains of southeastern Russia, where it has long been a troublesome weed. It found its way into the United States in 1873 or '74, having been brought to South Dakota in flaxseed imported from Russia. The land where it was introduced being somewhat broken, and corn the principal crop, it did not at first spread very rapidly. It was not till about 1888 that it had thoroughly established itself in South Dakota, but about this time it spread beyond her borders and invaded North Dakota on one side and Iowa on the other.

From this time on its dispersal has been rapid beyond all precedent. History records no instance of so much territory invaded by any plant in so short a time, for in these few years it has appeared in nearly all the States from California to New York, and from Canada on the north to Kansas and Colorado on the south.

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*Mr. L. H. Dewey, Assistant Botanist of the Department of Agriculture, has studied the Russian Thistle in all of its aspects very carefully. The results of his investigations have been published in Farmers' Bulletin No. 10, 1893; and a much fuller report in Bulletin No. 15 of the Division of Botany. These publications are the sources from which much of the information concerning this weed has been drawn for the now rather extensive literature upon the subject. Several of our Experiment Stations have, however, added greatly to our knowledge of it. All of these sources have been freely drawn upon by the writer, who hereby gratefully acknowledges his indebtedness.

Two causes have contributed to this unapproachable record, viz: first, its peculiar facility in distributing its seeds, naturally on its own account, artificially, by man's aid, in hay, in grain, and in seeds generally; second, suitable soil and favorable climatic conditions. It is just one more instance of the fact that some plants and animals, when transferred to a new locality, find more favorable environments than in their native home. Most of our truly troublesome weeds are of European origin.

ITS HISTORY IN WYOMING.

Though reported from a few points in the State in 1893, it is probable that all such reports were due to persons mistaking other more or less similar plants for the one in question. At least this was so in the cases verified.

Not till the fall of 1894 was an authentic specimen communicated to this Station. This was received from Mr. F. J. Stanton, of Cheyenne, who wrote that it was fairly well established at some points near the railroad. A press bulletin was at once issued sounding a note of warning, which received large publicity through the papers of the State. To this in part may be due the apparent freedom from the weed except along railroad lines, for this placed every suspected weed under the ban.

In 1895 specimens were received from Douglas and Frederics, and this season, 1896, the writer has observed it in a large number of places, in fact at every railroad point visited in a somewhat extended botanical collecting trip.

On the line of the Union Pacific it was plentiful both at Laramie and Cheyenne, at the latter place in all waste ground, sometimes almost to the exclusion of other weeds. On the Cheyenne and Northern, specimens were not rare at Wheatland, Uva, Badger and Orin Junction. The crop on the Elkhorn at Lusk, and on the Burlington at Newcastle, Moorcroft, Sheridan, Ranchester and Parkman was even more prolific. As these, the only points at which personal investigation was made, were all infected, it seems justifiable to suppose that the weed is found at most points upon all of these lines.

Prof. W. C. Knight, of this Station, reports it abundant at Casper and at various points upon the freight road between that point and Lander, viz: on Poison Spider Creek. At these points it has probably been introduced by seeds in the grain which the freighters have fed at the camping places along the trail.

METHODS OF DISPERSAL.

The Russian Thistle belongs to the class of weeds properly called *Tumbleweeds.* It is not a thistle at all, and has been so called only on account of its spines. It would have been more in keeping to have called it the *Russian Tumbleweed.*

Tumble weeds are plants which usually branch freely, assuming in the course of growth a somewhat spherical form. These plants are annuals, and when mature and dead the one comparatively slender root is easily snapped by the wind and the plant is set adrift, to be threshed over miles of prairie and plain by every storm. On treeless and fenceless areas they travel till worn out, and, as their seeds are not readily dislodged, the thousands* that each plant bears may be distributed over scores of miles. This, while true of all tumble weeds, is especially true of the Russian Thistle.

---

*A plant of average size, weighing when dry 3 or 4 pounds, it is estimated bears upwards of 30,000 seeds, while the largest, sometimes weighing 20 pounds when dry, bears 150,000 to 200,000 seeds.

But were this the only manner in which its seeds are scattered it would not be so bad, for there are some natural barriers which it would hardly cross. Hay and grain and seeds in general are sent from infected areas, bearing, perhaps, the one seed which serves to infect a new region. Stock cars in their hay and litter carry the seeds from State to State, as evidenced by the fact that almost invariably the points of first appearance are on railroad lines, particularly about stock yards and other places where cars are cleaned from time to time.

SPECIAL DANGER IN WYOMING.

The belief that Wyoming has more to fear from this weed than most of the other States is based upon the following facts : The Russian Thistle belongs to a family of plants, the Chenopodiaceae, of which we have many native representatives. In common with many of these it thrives in all soils, but seems even to be favored by a percentage of alkali. Drought is no hindrance to it ; it matures a crop when all else fails.

Our large areas of unoccupied lands, treelees and unfenced, offer unobstructed and immediate dispersal.

While it is true that it is not able to establish itself in well sodded ground, it is equally true that the open and imperfect sod of many of our native grasses do not resist its encroachments. At several points along the railroads it was observed among Blue Stem and other grasses. Once established on the general range, where it is everybody's or nobody's business to destroy it, it will never be exterminated. Viewed from this standpoint then it cannot be attacked too soon while it is yet, chiefly at least, upon railroad lines and in and about our towns and villages.

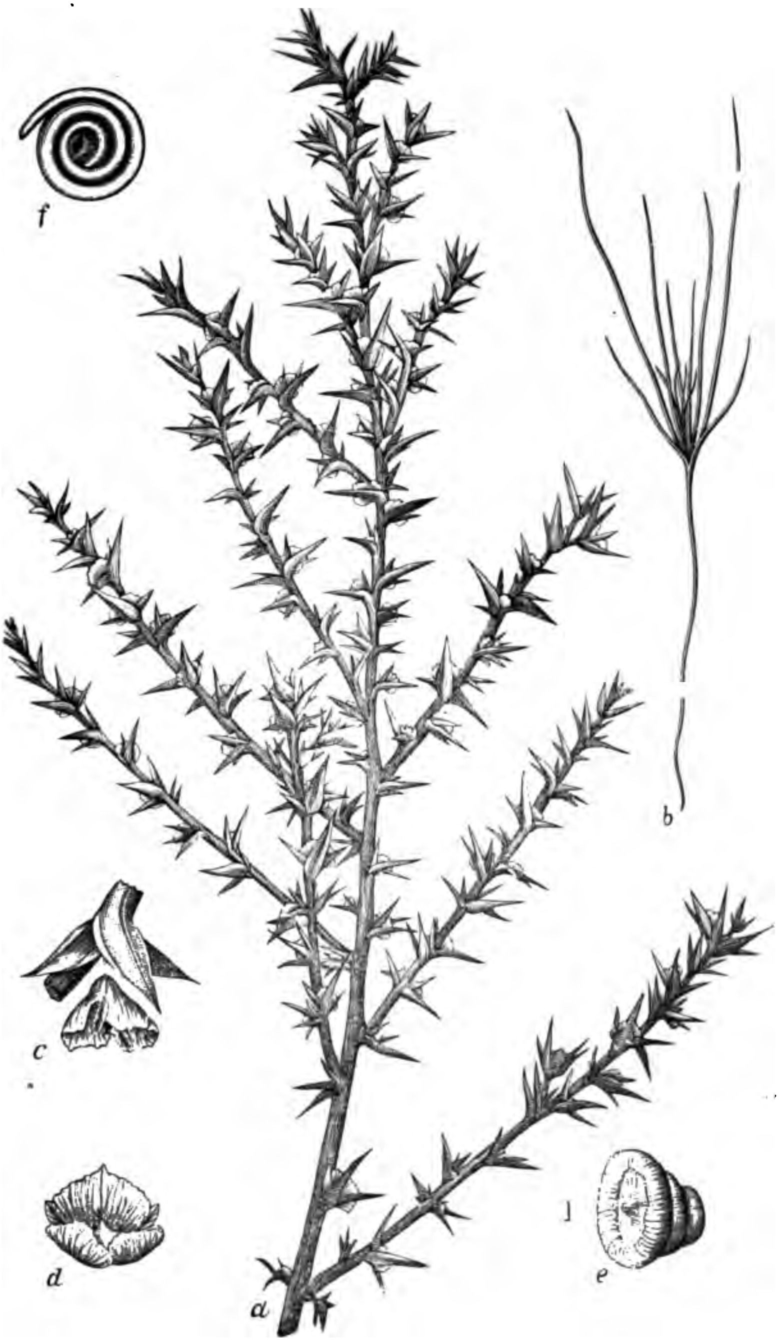

PLATE II.—RUSSIAN THISTLE. Detail figures. For references see description in text. (From Bulletin 15, U. S. Dept. of Agriculture.)

DESCRIPTION.

Technical description is purposely omitted, for I take it that those who are particularly interested wish simply the easiest method of recognizing it. To this end I give the following excellent popular description by Mr. L. H. Dewey, as given in the bulletins to which I have previously referred. The detail figures in Plate II, from the same source, and plates* I and III, will enable any careful observer to recognize the plant.

"In May and June the seeds germinate, each sending up on a slender red stem two narrow green leaves about an inch long and somewhat similar in appearance to shoots of grass. Between these seed leaves a short stem soon appears bearing slender spine tipped leaves, which later produce branches in their axils (Plate II, Fig. b). * * * Until dry weather begins the plants grow rather slowly, but they store up an abundance of moisture in the succulent leaves and branches. During the dry weather in August the moisture disappears from the slender leaves and they wither and sometimes fall off New shoots are formed which at first are short and densely crowded with spine pointed leaves less than half an inch long, but later elongate so that the leaves become separated at intervals of one-sixteenth to one-half inch (Plate II, Fig. a). Each leaf is accompanied by two bracts similar to the leaf itself, all spine tipped and projecting at almost right angles to the stem. A single, small, stemless flower grows in a cup-shaped depression formed by the bases of the two bracts. The outer parts, or perianth, of the flower are thin and paper-like in texture, spreading, when fully open, about one-fourth inch, and are usually bright rose color (Plate II, Fig. d). If the flower is taken out and carefully pulled to pieces a small, pulpy, green, coiled body appearing like a minute, green snail shell will be found (Plate II, Fig. f). This is the embryo or miniature plant. As the seed ripens its coat becomes of a dull gray color, and at maturity the whole seed is about one-sixteenth of an inch in diameter, irregular in form, and of about one-half the weight of a flax or clover seed (Plate II, Fig. e).

During August and early September the plants become rigid throughout and increase rapidly in size, often growing 2 or 3 feet in height and 4 to 6 feet in diameter, forming a dense, bushy mass of spiny branches (Plates I, III, and Plate II, Fig. a). By the middle of September the exposed parts of the plants have usually changed in color from dark green to crimson or rose red. When the ground is frozen in November the entire plant, except the seed, dies. The root is broken by the force of the wind and the plant is blown about by the wind as a tumbleweed."

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*The frontispiece, Plate I, has kindly been loaned to this Station by the Ohio Station; and for the use of Plate III we are indebted to the Wisconsin Station.

ITS PERNICIOUSNESS.

The Russian Thistle has no good points worthy of consideration. Some claims have been made for it as a forage plant, but its value in that direction should have no weight whatever when it is understood that it has no advantage over many others with no noxious qualities. It cannot be eaten by stock on the range except during the summer months (June and July), when other palatable feed is abundant.

In cultivated grounds it is a weed first, last, and all the time, robbing the soil and crowding out the crops. This is especially its history in grain fields, where it not only greatly reduces or exterminates the crop, but greatly impedes the process of harvesting, damages the machinery, and injures the horses' legs to such an extent as to form festering sores.

The large, rigid plants greatly interfere with all farm operations, and the dry plants, when banked against fences, corrals and stock yards offer inviting pathways for chance fires.

METHODS OF CONTROL.

It is an annual, hence if plants are not allowed to produce seed it will soon be brought under control.

It is not difficult to kill; if plowed completely under or if cut down with a hoe it dies; if mowed off below all of its branches at proper times it will suffice. If cut or mowed after blossoming the seeds are often matured from the sap of the somewhat succulent stems, hence all plants approaching maturity must be burned to make sure that they will not distribute any seed.

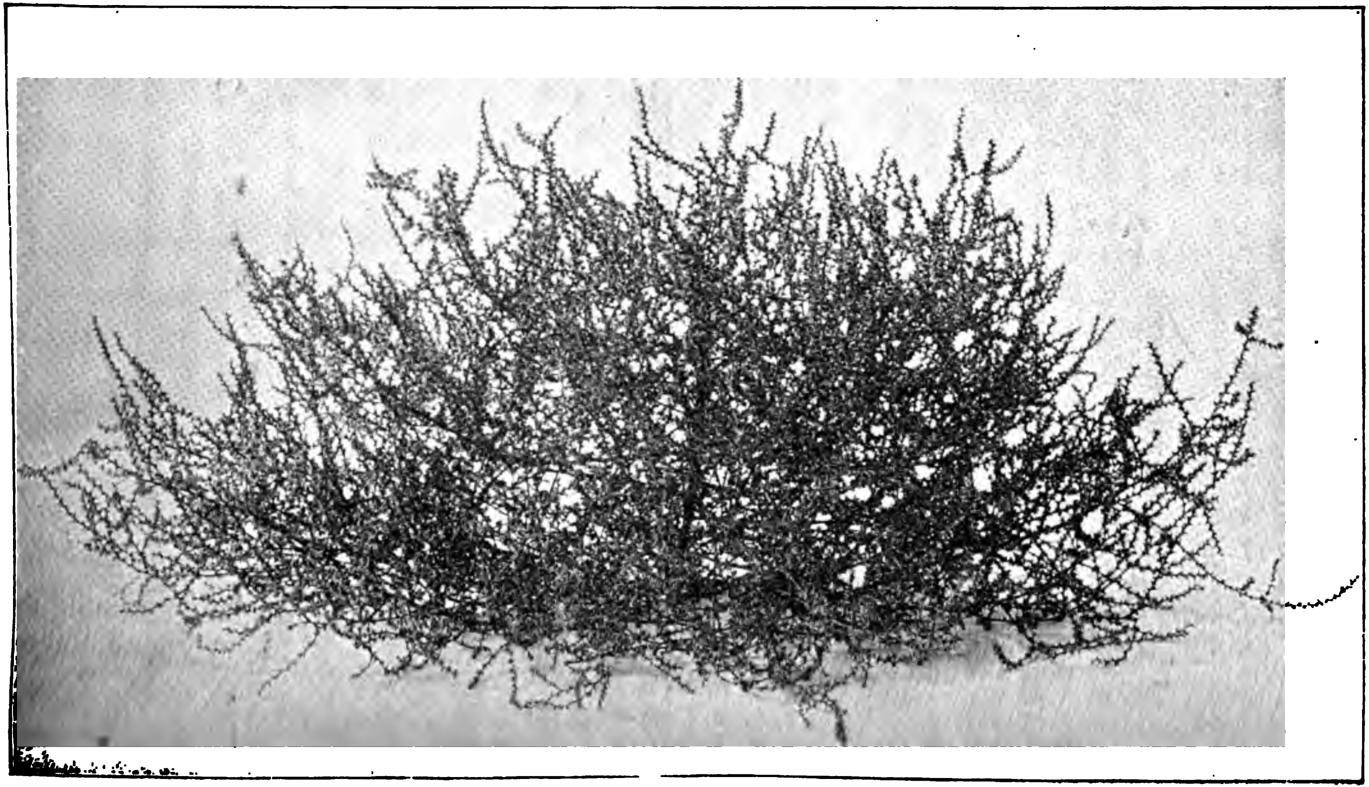

PLATE III.—RUSSIAN THISTLE. [illegible]

As it is rather inconspicuous when young, but develops rapidly and to such enormous proportions late in the season, cultivated, and in fact all suspected areas need to be gone over in late August or early September to see that no isolated individuals have been overlooked.

Vigilance, and the free use of the plow and harrow, the hoe and the scythe, will soon rid a farm of it, but unless there is the completest co-operation of all the residents of a community the ground will soon be re-seeded again. It is just as essential to its extermination that my neighbor shall destroy them on his place as that I destroy them on mine. This will not happen till we have a thoroughly aroused public sentiment, backed by a just and enforceable law. To secure this sentiment it should only be necessary to make thoroughly known the character of the weed and the dangers that it threatens, and to furnish means for its recognition. On these points it ought to be made impossible for any one to remain in ignorance. As Mr. L. H. Dewey has said*, "make the pupils in the schools familiar with it, teach them to destroy it, as they would a rattlesnake, wherever they see it." Let the watchword be: "*Kill it.*"

When it is known that in some counties in our neighboring States this pest is in such complete possession that many farmers are abandoning their fields in despair, and that farm valuations on account of it are greatly diminished, it ought to spur us all on to secure its extermination in Wyoming while it may yet be within our control.

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*Farmers' Bull. No 10, U. S. Dept. Agriculture.

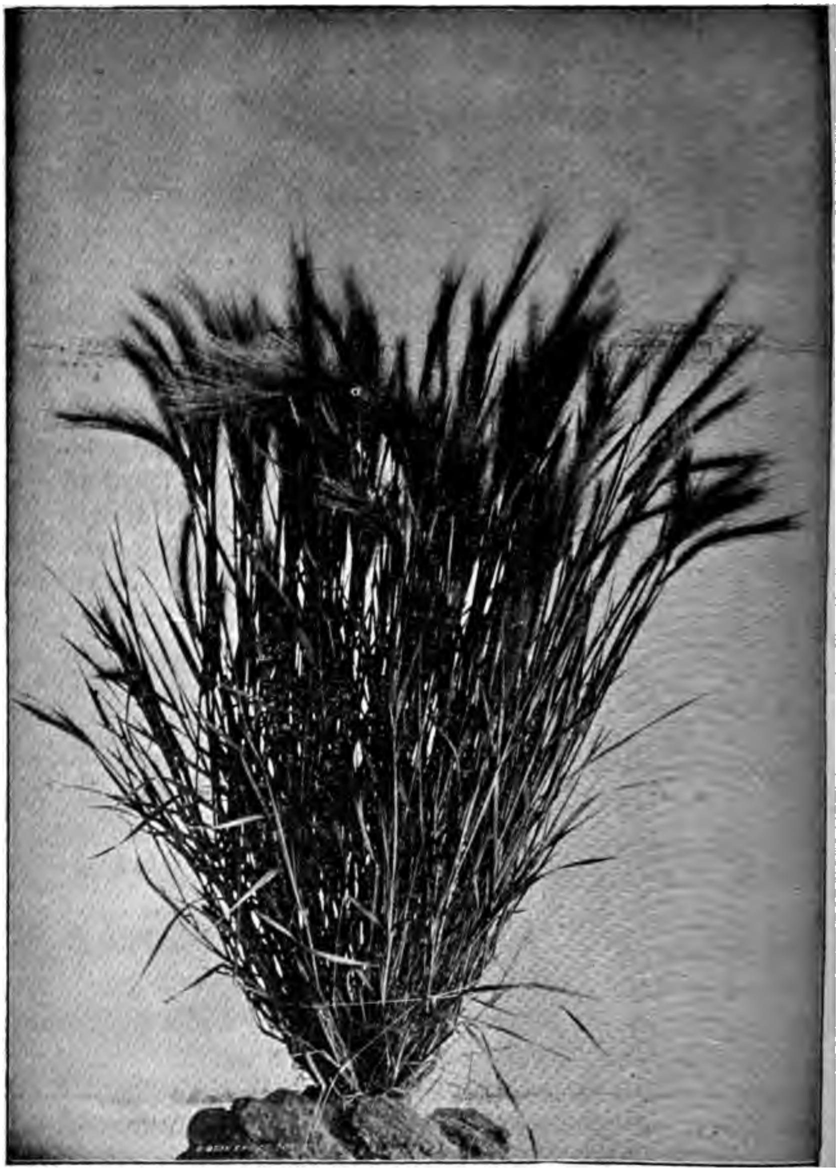

PLATE IV.* SQUIRREL TAIL GRASS (*Hordeum jubatum* L.)

*This excellent plate, as well as plates V, XI, XII and XIII, we are able to present through the kindness of Prof. Chas. S. Crandall, Botanist of the Colorado Station. The weed conditions of the two States are so similar that we were glad to avail ourselves of the excellent work that had been done for Bulletin 23, "Colorado Weeds," in which these plates first appeared.

SQUIRREL-TAIL GRASS,

Fox-Tail, Wild Barley (Hordeum jubatum L.*)*

In a State where hay forms so staple and important a crop as in Wyoming, the worst weed of our meadaws must receive attention. In the opinion of the writer there is no one weed that so much concerns hay producers and hay users as this. Not because it is ever likely to take complete possession of our lands, as the Russian Thistle threatens to do, but because, so long as it is endured in our meadows, much hay must be quite unfit for use. How any one who knows its worthless character and the injuries that it inflicts upon stock can for a moment think of using hay in which it is found in any appreciable quantity, is incomprehensible. Selfish interests, as well as humane considerations, forbid its use.

This annual grass is, as soon as it heads, a pest and only a pest. Its light seeds, armed with the long barbed bristles, are carried everywhere by the wind, in the waters of our irrigating ditches and on our streams, and even by animals in their hair and wool.

With such easy dissemination the plant readily spreads to all fields where suitable conditions are offered. Unfortunately suitable conditions are often unwittingly created by the ranchman himself. By over-irrigation, particularly during the spring months, the native or cultivated grasses are wholly or partly killed out and the vacated soil is promptly occupied by this hardy indigene.

Being an annual it is not so very difficult to bring it under control. Infested meadows may be cut before the Squirrel-Tail heads, and if they are cut a second time during the season this will practically exterminate it, if fence corners and turning rows are not maturing plants for the re-seeding of the ground.

Where it is in complete possession of a meadow the safest and best means is to break up the ground and plant to a cultivated crop for a year or two. This is always effective and probably the shortest road to a well-sodded meadow again, for the considerable presence of this weed in any field indicates that the better grasses have run out.

In this State there are many valuable meadows of native grasses which are being ruined by injudicious methods of irrigation. Constant flooding drowns out the better grasses, which are then replaced by seeds and rushes, or, worse yet, by Squirrel-Tail Grass. It is to be hoped that more judicious methods may prevail, and that the remarkably nutritious native grasses may still be saved in many meadows.

No description of this is needed; it is known to all, or if not, may easily be recognized from the accompanying plate.

More complete information as to the structure, the mode of dissemination, the injuries resulting from this weed and the best methods of exterminating it, can be obtained from a bulletin by the writer*, No. 19 of this Station, and from one by Prof. L. H. Pammel†, of the Iowa Station.

COCKLE,

Cow Herb (Saponaria vaccaria L.)

Cockle is known to all the farmers of this State by name at least. Many have learned to know it at sight by reason of much bitter experience. This is at present the

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*Squirrel-Tail Grass (Fox-Tail), One of the Stock Pests of Wyoming.
†Bulletin No. 30, Expt. Station, Ames, Iowa.

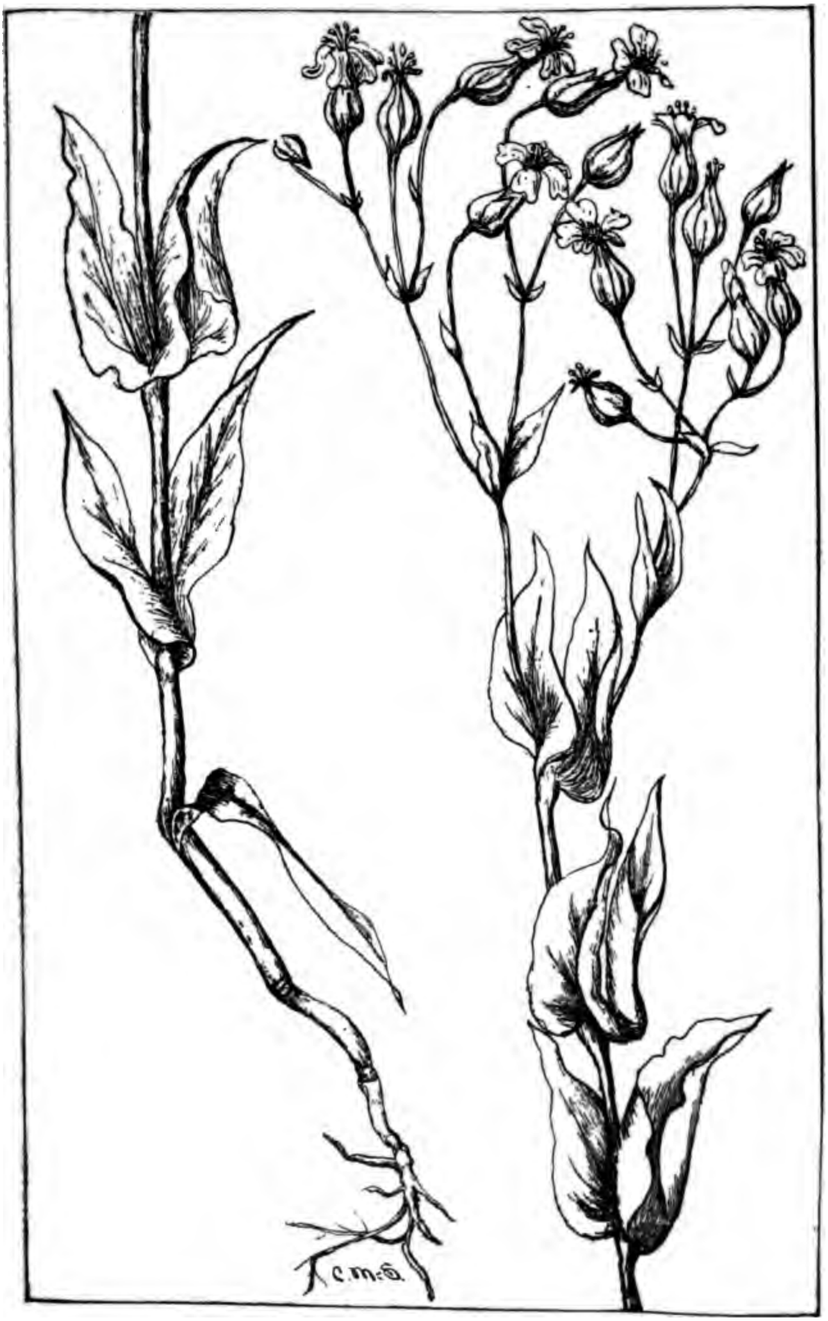

PLATE V.—COCKLE (*Saponaria Vaccaria* L.)

worst weed in grain fields. In cultivated fields it causes very little trouble, as it is as readily destroyed as other weeds ; but in fields of spring wheat, especially, much damage is done by this plant. Springing up with the wheat the latter is crowded out, shaded out, and robbed of the food it might otherwise get from the soil. The result is a greatly reduced crop of inferior quality.

Like most of our bad weeds it is an introduction from Europe, but it is so well established now in this country and in the wheat growing sections of Wyoming that where it came from is only of historical interest. How to keep it out of our grain fields is a practical question, and I think one which can be answered.

This is a case where prevention, rather than cure, must be sought. A field well seeded to Cockle, as well as wheat, is practically beyond redemption. The remedy lies in clean seed on clean ground. This is not so difficult of attainment as many suppose. Suspected seed wheat, if it must be used, should and can be cleaned by screening. This should be sown on clean ground. Let the ground known to be full of Cockle seed be used for cultivated crops till the Cockle has been exterminated. To avoid having to fight and endure loss from it every year see that road sides, fence rows and vacant grounds are not maturing plants and seeds to undo all your other work.

This annual may be known by its smooth, opposite leaves, united by their bases, by its rather large pink flowers in a strongly five angled calyx which becomes much enlarged in fruit. It usually grows 18 inches to 2 feet high and branches above.

These characteristics in connection with the figure of it (Plate V), will enable any one to determine suspected plants.

CANADA THISTLE,

(Carduus arvensis Robs.*)*

This is one of the true Thistles and not merely one in name. It has been talked of and written of for years throughout the United States, and as a result it has come to be so dreaded that wherever it has appeared relentless war has been waged upon it. This, however, has not exterminated it, but it has kept it in check. That this commendable vigilance against this foe might not relax, many States have placed this in the list of weeds proscribed by law; in fact, it was among the first, if not the first, against which laws were enacted.

This weed is now in Wyoming. The writer found a patch in a stock yard on a farm near Sheridan in July of this year. It was also reported from there, with specimens, in 1895. It is probable that some effort was made to exterminate it at that point, but it is very probable that it has entered the State at other places.

Every one should be on the lookout for this invader, as it is comparatively easy to dig out a few, but when a large area is infested it is a costly undertaking. I use the words *dig out* advisedly, for it cannot be destroyed by ordinary methods.

It is a perennial plant; that is, it lives for a number of years, dying down to the ground only, each year. It is reproduced by seeds, which are furnished with a tuft of hair, that the wind may the more readily carry them long distances. This accounts for the rapidity with which it

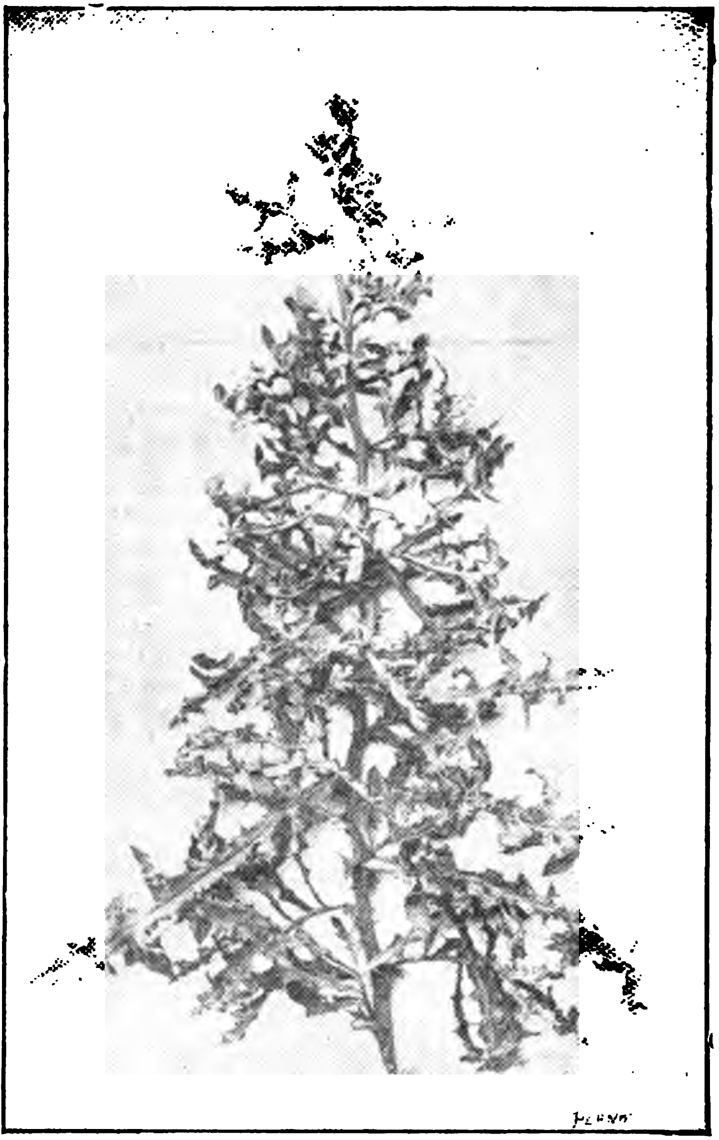

PLATE XI. CANADA THISTLE (*Carduus arvensis* Robs.) Entire plant, showing habit of growth.

spreads, but the difficulty of killing it out where it has become established is quite another matter. Examination reveals the fact that each plant is furnished with a number of long, slender, underground stems, which at intervals give rise to new above ground stems. This, then, is a second means of reproducing the plant, and gives it its well-known tenacity of life. Ordinary stirring of the soil only increases the number of individuals, as each piece of the broken up underground stems promptly sends up a new shoot.

PLATE VII. CANADA THISTLE. Part of a plant, showing leaf and head more in detail.

It can be destroyed. The first rule is that it must not be allowed to seed, otherwise new areas will be infested by the seeds blown away by the wind. To destroy it where established, if the area be large, recourse must be had to some method of cultivating the soil which shall entirely keep down the above ground parts, thus starving to death the underground stems. All underground parts, while capable of living for a time without food, ultimately require food prepared for them in the leaves of the plant. Any method then which shuts off this source of supply will be effectual. Repeated plowing may be depended upon, but only an occasional stirring of the soil, especially if the ground be wet, is of advantage to the weed.

In small areas dig them out entire, smother them by building stacks over them, or keep them cut below the surface for a season, or two if necessary.

That all may recognize this weed and attack it at once wherever it appears, two figures are given, one (Plate VI[*]) showing the plant entire, and the other (Plate VII[†]) showing some of the heads more in detail.

It grows two feet or more in height, is usually green and smooth, with weak prickles upon the margins of its lanceolate leaves. It branches freely, producing numerous, rather small (one-half inch) heads with rose purple flowers. It may be known from the Bull Thistle, described next, by its underground stems and by the absence of wing-like margins on the stem and of cottony wool on the under surface of the leaves.

BULL THISTLE.

Common Thistle (Carduus lanceolatus L.)

This large, common, roadside Thistle must be familiar to every one. It also has come to us from Europe, and, like the Dandelion, almost keeps pace with civilization. It is introduced into new areas chiefly in seeds, grains, hay, and the packing materials of goods imported.

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[*] Through the courtesy of the officers of the Oregon Station we are able to present this plate of the Canada Thistle, as well as the two of the Bull Thistle.

[†] For the use of this plate we are indebted to the Illinois Station, as we are also for Plates X and XV, used in this bulletin.

Those not familiar with it may know it by the following description* and figures (Plates VIII and IX).

"It is a biennial, producing the first year simply a tuft of large, spiny leaves spread out flat upon the ground; the second year it sends up a stout, erect, branched stalk, two to four feet high, blooms, bears seed and dies. It may be distinguished from the Canada Thistle by the large flower heads (1 to 1½ inches in diameter), and the wider, stemless leaves, cobwebby beneath, with margins running down the stem as ragged wings, which make the stalks very prickly."

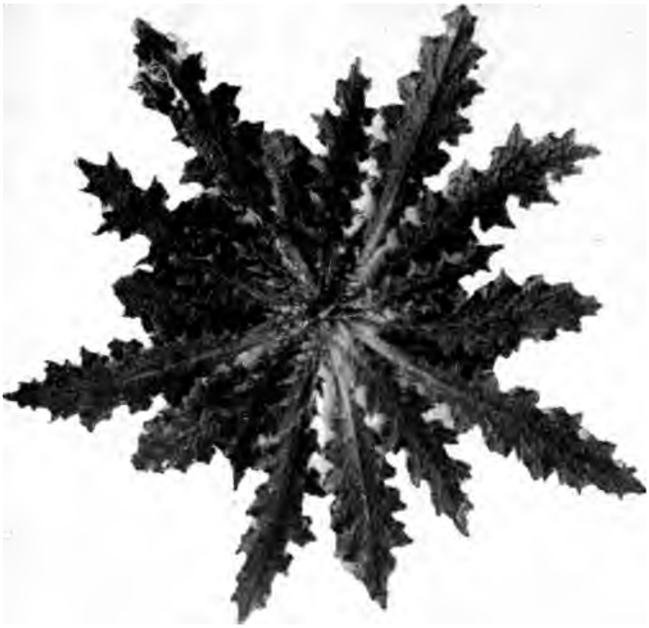

PLATE VIII.—BULL-THISTLE (*Carduus lanceolatus* L.) Plant as it appears during its first year's growth.

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*By Prof. Moses Craig, in Bull. 32 of Oregon Station.

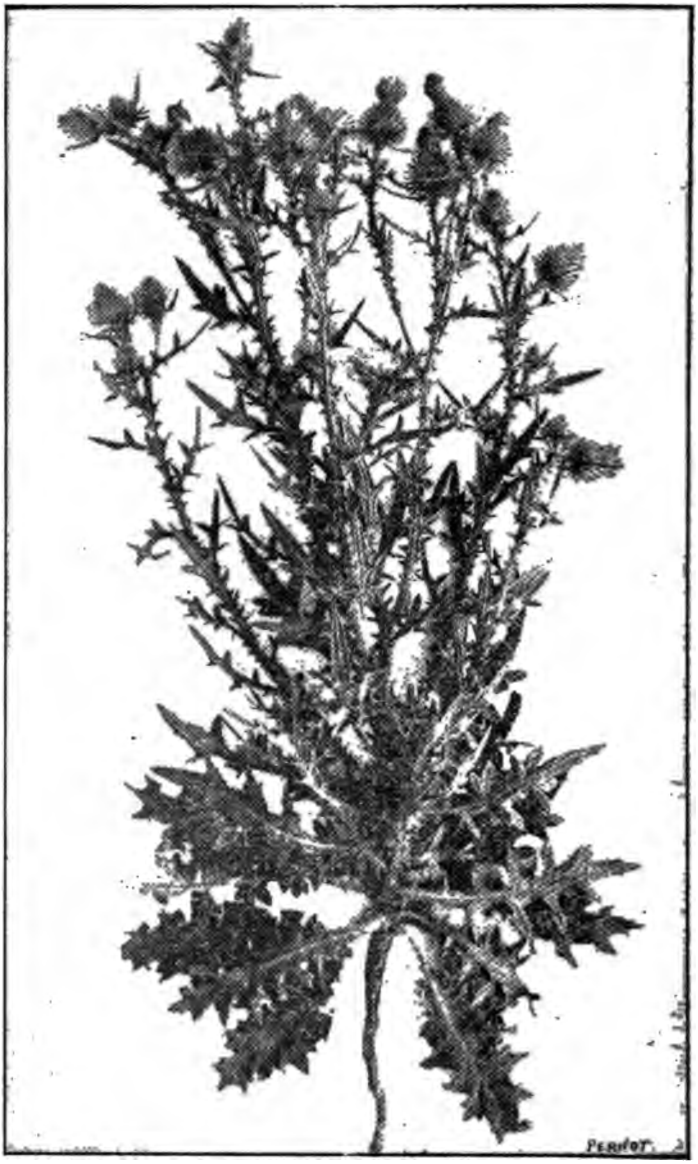

PLATE IX. BULL THISTLE. Mature plant as it appears the second year.

This Thistle is not so difficult to exterminate as the Canada Thistle, and if no plants were allowed to seed for two years the work would be done. The plants are themselves readily killed, for if cut below the short crown they rarely come up again. This can be done quickly with a tool called, by Mr. L. H. Dewey, a spud*. This is a chisel shaped tool with a long handle. The writer has found a carpenter's stout, narrow chisel effective, but more rapid work could be done with a heavier tool on a long handle. A single thrust ought to suffice to cut the largest plant two or more inches below the surface.

The weed gives no trouble in cultivated ground, but often becomes a nuisance of the worst sort in pastures. The large rosette of leaves and the spreading branches, with their long, formidable spines, not only reduces the productive power of the land, but renders unavailable the grass that does grow, for few browsing animals venture to contest with the Bull Thistle its pre-empted area.

It also springs up along roadsides, in waste ground, and even in lawns, in all of which it produces a most slovenly and unsightly appearance. A few weeds left to fruit in such places will render of no avail what has been done in the field ; the wind catches the seed with its tuft of hairs and whirls it along, possibly for miles, and the new crop of course proves just as troublesome as the first.

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*See Farmers' Bulletin No. 10, U. S. Dept. Agriculture.

WILD OR PRICKLY LETTUCE,

Compass Plant (Lactuca Scariola L.*)* Plate X.

Once more Europe has furnished a most vigorous but insidious foe. Though introduced into this country nearly a quarter of a century ago, it is only within the last few years that this tramp has attracted universal attention. In some respects a rather inconspicuous plant, it established itself everywhere before it came under the ban. It is even more widely dispersed than the Russian Thistle, for it has spread from ocean to ocean. In Wyoming, however, it is still rare, only one patch having been observed, viz : on the Cheyenne and Northern, in the Platte Canon. In many other States it has become so abundant that its extermination is no longer considered a possibility*.

It should be an easy matter in Wyoming, where it has no serious foothold as yet, to keep this pest in complete control. It is an annual weed, no more difficult to kill than most annuals, except for the large number of seeds so widely dispersed by the wind.

Prevention of seeding is the remedy, and if the plant is half so troublesome and unsightly as it is said to be elsewhere, the farmers of the State will do well to learn to recognize it. Let the first plants that appear be uprooted before any seeds are mature.

The following points are selected from Dr. J. C. Arthur's bulletin, already cited.

"It is closely related to the garden lettuce, having many of the same characteristics, but with the edge and midrib of the leaf and the lower part of the stem beset with weak prickles. It blossoms in July and August. * * * Correspondents, and writers in the press unite

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*See Bull. 52, Vol. V, 1894, of the Indiana Station, Dr. J. C. Arthur.

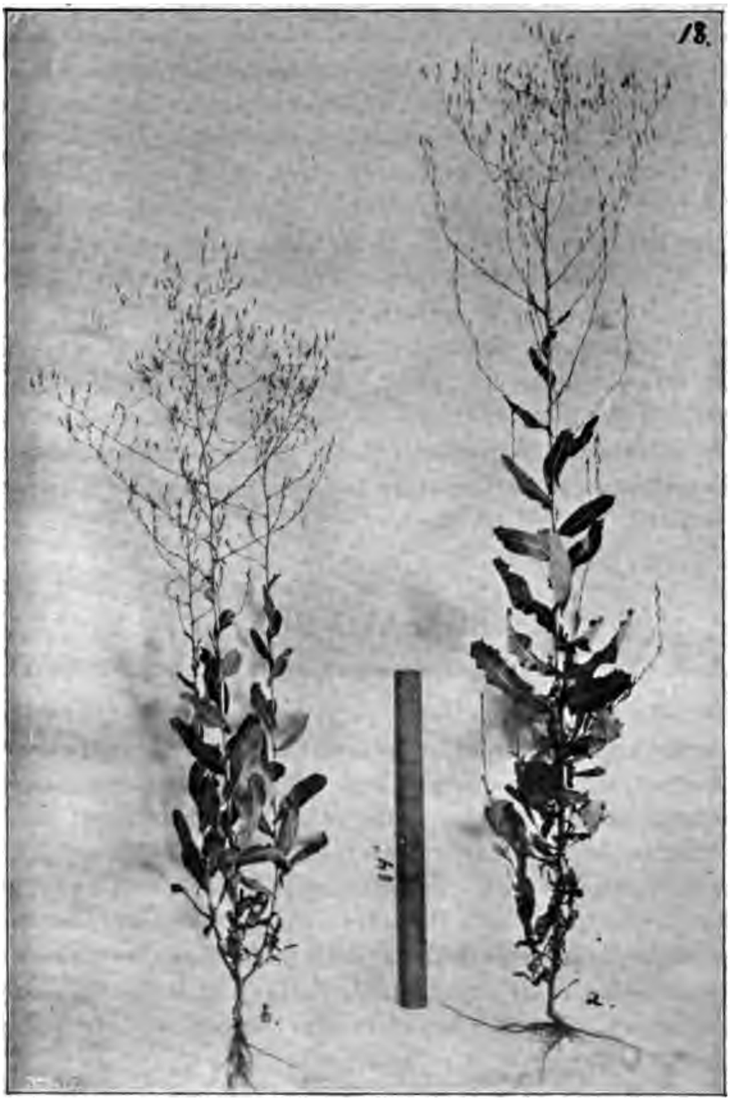

PLATE X.—PRICKLY LETTUCE (*Lactuca scariola* L.) Showing its usual form of growth; also its habit of sending out new shoots if cut off.

in considering this a prominent and disagreeable weed. The plant has many of the qualities of a successful intruder as well as an uncompromising weedy appearance. * * * It becomes an important portion of all weed patches. * * * When the top is injured sprouts are sent out from the base of the stem in a very troublesome manner. * * * The plant has a curious habit of twisting its stem leaves into a vertical position, with the edges directed north and south. It is one of two well marked compass plants. * * * Remember the persistent habit of the plant to throw out sprouts unless cut off below the surface of the ground. * * * A suitable weed law should exist so that dilatory land owners may be brought to action."

BUFFALO BUR,

Beaked Horse-Nettle (Solanum rostratum Dunal.*)* Plate XI.

We will now consider very briefly one of the native weeds which has in other places been very strongly condemned, viz : the Buffalo Bur. It has been observed in several places in the State, usually in sandy ground. From no locality has it been reported as a bad weed, and it is mentioned here chiefly because it has proven that it has weed qualities. It is travelling eastward from the western plains, and in spite of all precautions seems to be establishing itself victoriously in all of the Mississippi valley States. Since it has shown its qualities elsewhere it is just as well to give it no quarter here.

It is a branched annual, one or two feet high, with a rather large lobed leaf. It may be known by the stout yellow prickles which cover both stem and leaf; by the

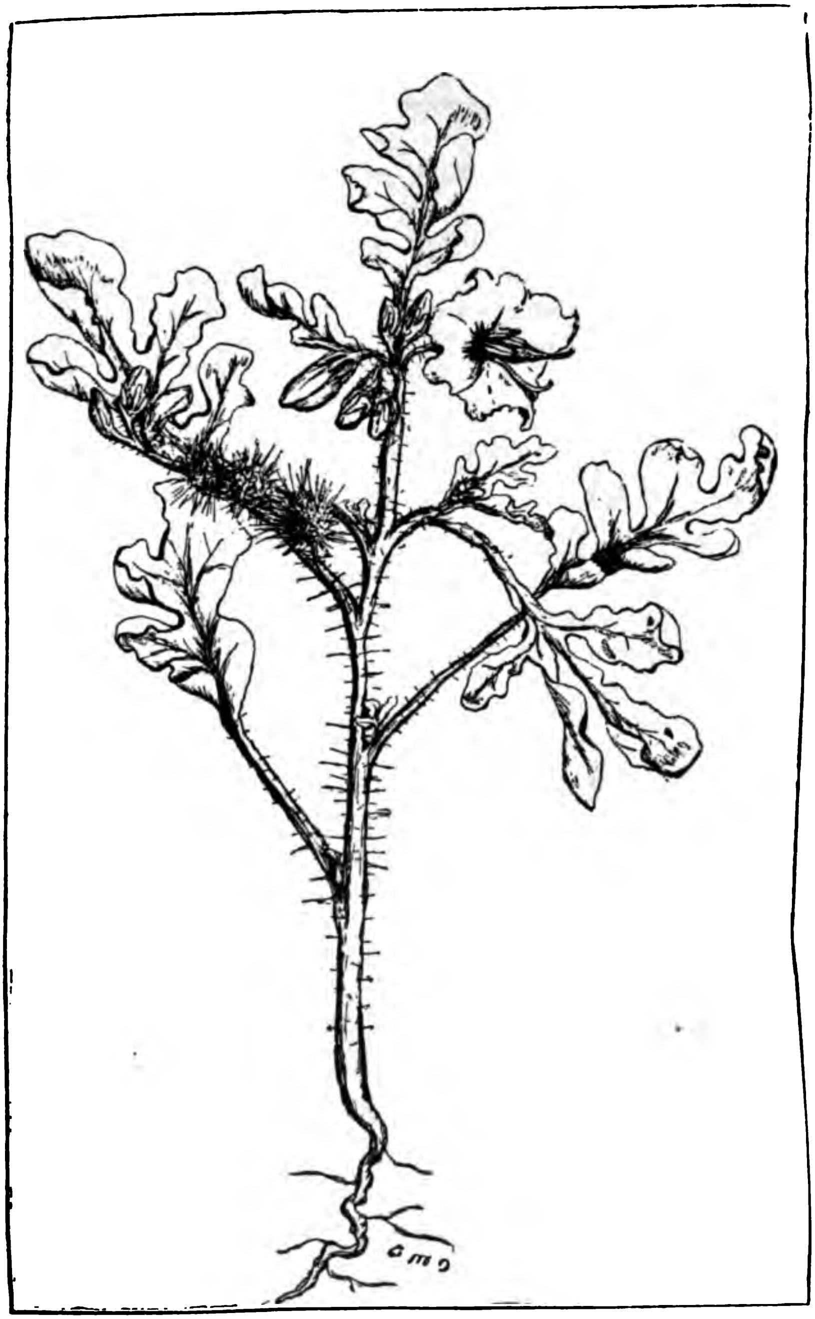

PLATE XI.—BUFFALO BUR (*Solanum rostratum* Dunal.)—A small plant.

yellow flowers, nearly an inch across, shaped like the blossom of the tomato and potato, to which it is botanically related, and by the horridly prickly calyx which permanently encloses the fruit. The enlarged calyx with its yellow spines produces a bur-like effect, and explains the origin of its common name.

POVERTY WEED

(*Iva axillaris* Pursh.) Plate XII.

This is a bad weed to get rid of when once introduced, but fortunately it is not generally prevalent. It is a perennial, with running underground stems, the breaking up of which by plowing or hoeing only enormously multiplies the weed. It must be dug out entire or the root stocks starved to death by keeping down all leaves and stems. This can only be done by very frequent cultivation. Infested ground can also be cleared by smothering the weed with heavy seeding to grain or Alfalfa, or better yet, a close sod of the common meadow grasses.

It grows 6 to 10 inches high, branches somewhat and forms dense patches in favorable soil. In the axils of the oblong leaves are produced small, yellow, drooping heads, which produce a moderate amount of seed.

PERENNIAL FRANSERIA,

(*Franseria discolor* Nutt.) Plate XIII.

For this plant no common name is known to the writer, so Perennial Franseria may be adopted. Botanically it stands near the Ragweeds, as does also the Poverty

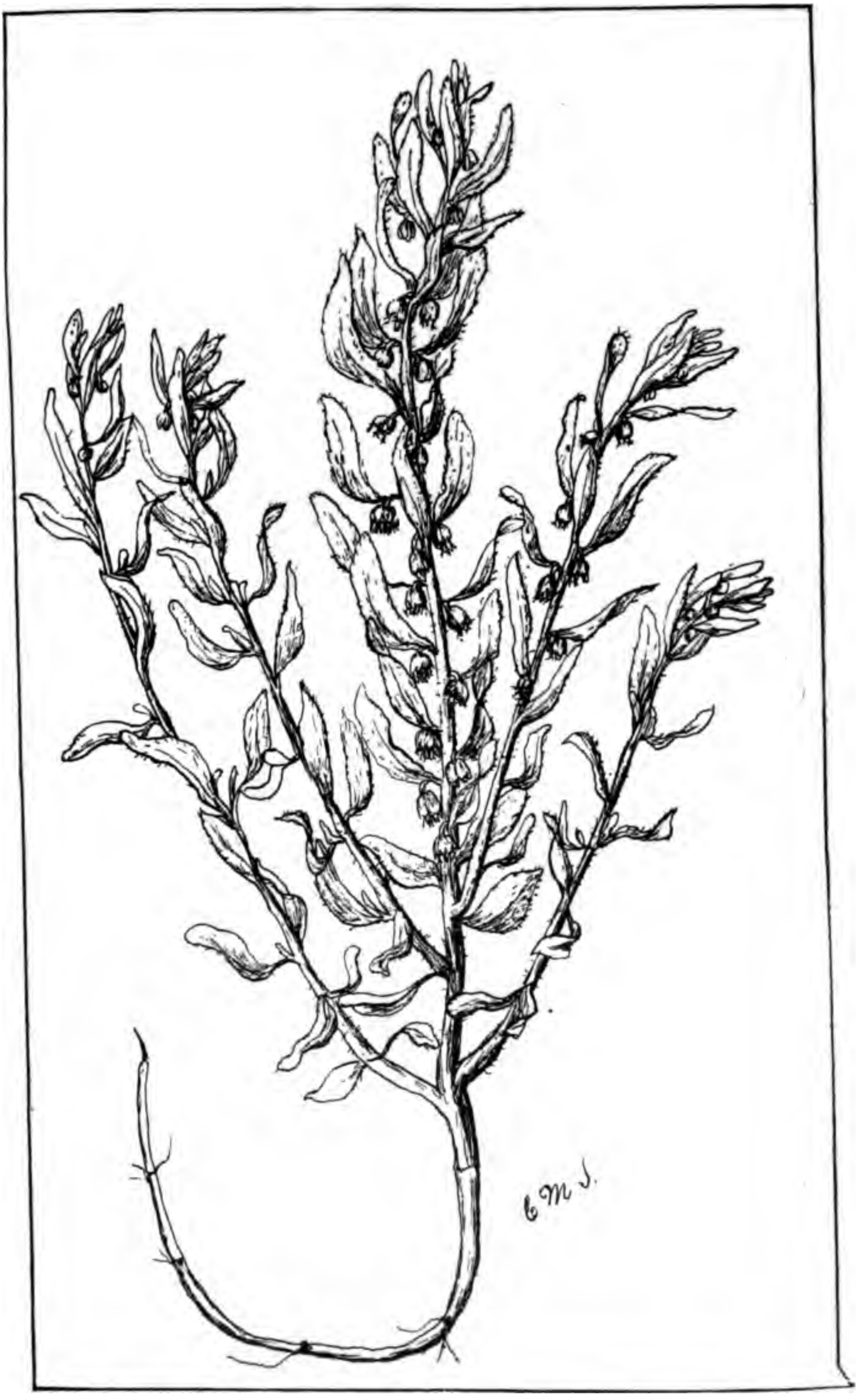

PLATE XII.—POVERTY WEED (*Iva axillaris* Pursh.)

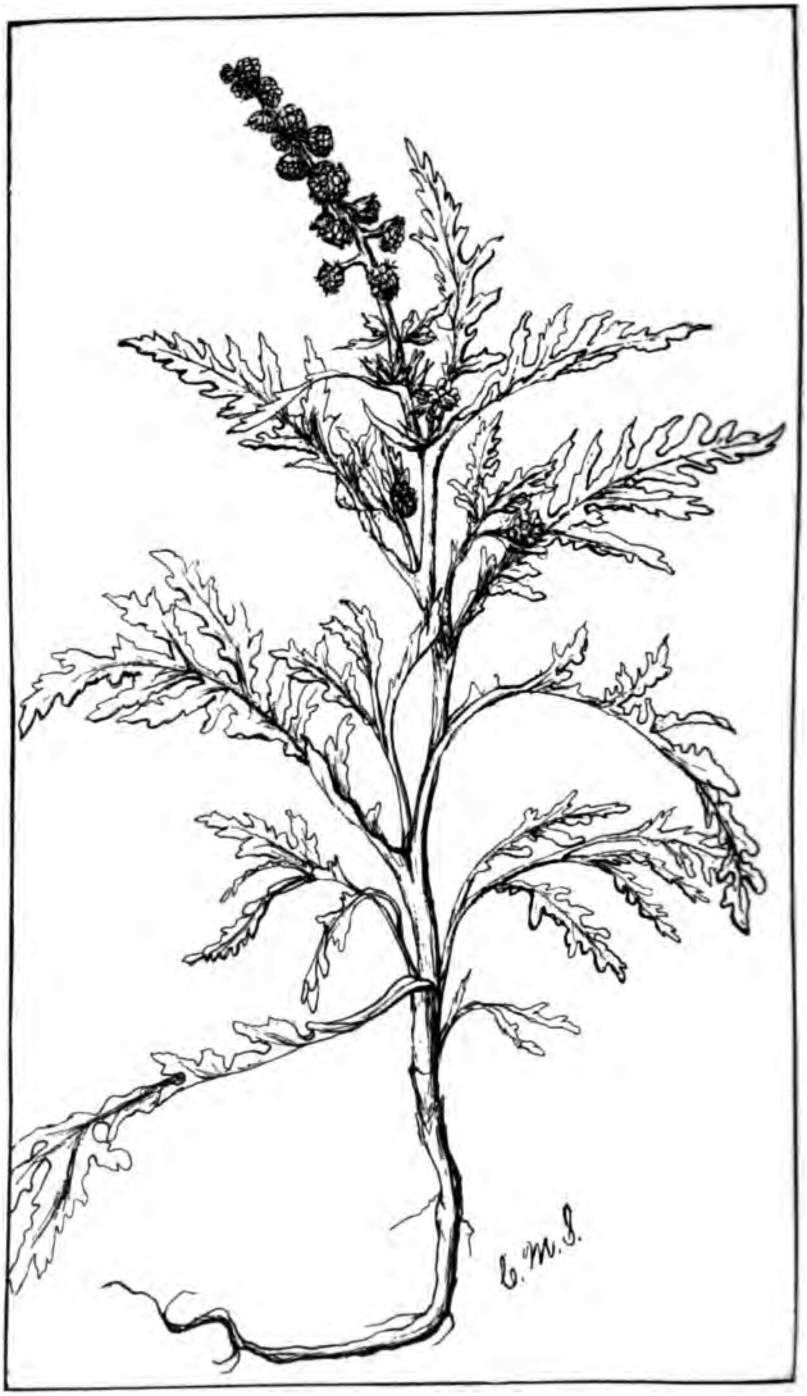

PLATE XIII.—PERENNIAL FRANSERIA (*Franseria discolor* Nutt.)

Weed. Like the Poverty Weed, it is a perennial, and may be compared to that in its mode of life and reproduction. It is more common in the State and still more difficult to eradicate, as it adapts itself to all soils. It has been reported from some localities as defying all attempts to remove it. It readily crowds out all garden or cultivated crops unless hand weeding is repeatedly resorted to. The same methods for its control as for Poverty Weed are suggested. The accompanying plate shows two characteristic plants. They usually grow so densely, however, as to cover the ground as with a mat, and are 4 to 6 inches high. The flower stock overtops the dissected leaves, which are green on the upper surface and whitish beneath.

Another species of this genus *(Franseria Hookeriana* Nutt.*)*, is common in sandy soil, but has not been reported as a weed. It produces a very spiny bur-like fruit.

THE PIGWEEDS

(Amaranthus) Plates XIV and XV.

The Pigweeds, of which there are several species, are found in nearly all cultivated grounds throughout North America. Originally the forms that are now commonest were confined to tropical and western America. These are Thorny Amaranth *(Amaranthus spinosus* L.*)*, Common Pigweed *(Amaranthus chlorostachys* Willd.*)*, Rough Amaranth *(Amaranthus retroflexus* L.*)*, Low Amaranth *(Amaranthus blitoides* Wats.*)*, and Common Tumbleweed *(Amaranthus albus* L.*)*. Only the last three of these are common in Wyoming. and the last two are indigenous. They are all annuals, and attract no particular attention except in cultivated ground, where, if once established, they furnish seed enough each season for several bountiful crops successively produced, springing up afresh after each cultivation of the land.

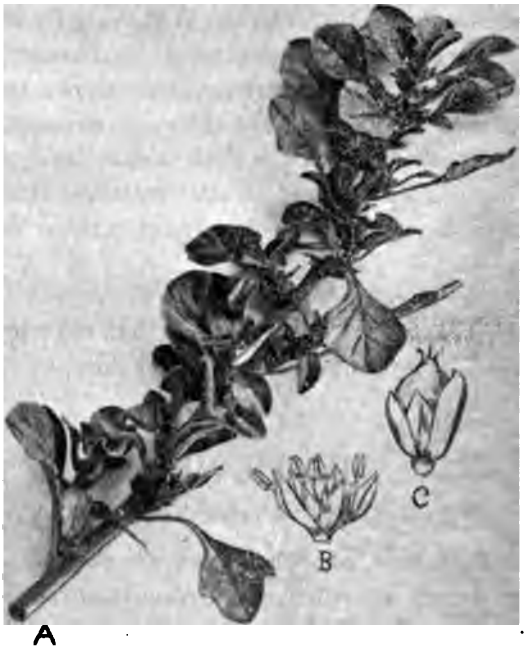

PLATE XIV. LOW AMARANTH (*Amaranthus blitoides* Wats.)
A, Extremity of branch. *B*, A staminate flower. *C*, A pistillate flower

Of the Rough Amaranth I am unable to present a figure, but it may be known from our other Pigweeds by its erect habit and short, thick, erect spikes, which are almost as long as the terminal one.

The Low Amaranth branches from the base, and has a decided spreading habit, being in many instances quite prostrate. Plate XIV[*] shows the end of one such branch. In several instances farmers have pronounced this their worst weed.

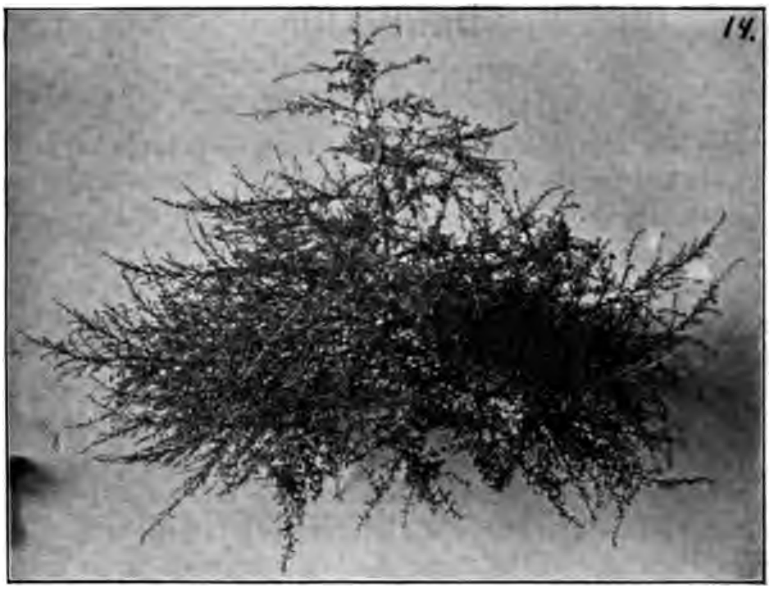

PLATE XV.—COMMON TUMBLEWEED (*Amaranthus albus* L.) This is the plant most frequently mistaken for the Russian Thistle.

The Common Tumbleweed is frequently mistaken for the Russian Thistle, which it closely resembles in form. It may, however, be easily distinguished, for this has flat leaves, the Thistle never has; this has no spines, the floral bracts only becoming somewhat prickly when dry. Plate XV[†] shows it as a well developed tumbleweed.

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[*] From Bull. No. 21, Nevada Station, through the kindness of Prof. F. H. Hillman.

[†] This, as well as Plate X, originally appeared in Bulletin No. 39 of the Illinois Station, by the courtesy of whose officers we are permitted to present them here.

The remedy for all of them is clean seed and clean cultivation. Clean cultivation once inaugurated makes each successive year easier and easier. This self-evident truth applies to other weeds as well as the Pigweeds.

DANDELION

(*Taraxacum officinale* Weber.)

This is known to every one, and needs neither description nor illustration. It need not be considered as a weed but for the trouble it gives in lawns. Here it is pre-eminently the worst, for it establishes itself in even the most compact sod.

It is easily destroyed by destroying the lawn, but in Wyoming lawns represent too much time and labor to be sacrificed except as a last resort. It could easily be kept in control on individual lawns except for the crop on your neighbor's neglected lot and on the margins of the irrigating ditches in our streets. These furnish seeds enough, all with full spread sail, to re-establish the weed as often as you care to remove it. No remedy can be suggested except that each lot owner be urged or required to keep his own premises clear, including the streets and alleys adjacent to said lots. Until that is done there can be only eternal warfare and no respite from the service. When that is done the contest will soon be an easy victory for the lawn owner.

To remove this perennial from the lawn the best implement is a strong, but narrow (one-half inch) carpenter's chisel. With this the rootstock can be quickly cut some inches below the surface without injury to the grass. Unless cut low in the ground it comes up again.

Various remedies have been tried, such as salt, coal oil, etc., applied to the cut rootstocks, but, besides being too much labor, it is unsatisfactory at best. Unless applied in large quantities it is not effectual, for the Dandelion is hardier than the crop, and large quantities, besides being expensive, kill the lawn as well as the weed.

Plants cut out when in bloom should be burned, for otherwise they even then mature their seeds and send them off on every breeze.

To those in other States who may read this I will state that in Wyoming the Dandelion has apparently found its most congenial home. It is here in full growth and blossom from early spring till late autumn.

A Half Century of Weeds.

While it does not seem best to consider any more of our weeds in detail at present, it may be worth while to make record of those that have attracted some attention within the State.

Enumerating first those already discussed without further comment, the others follow with the very briefest data*.

1. **Russian Thistle** (*Salsola Kali Tragus* Moq.)
2. **Squirrel-Tail Grass** (*Hordeum jubatum* L.)
3. **Cockle,** Cow Herb (*Saponaria Vaccaria* L.)
4. **Canada Thistle** (*Carduus arvensis* (L.) Robs.)
5. **Bull Thistle,** Common Thistle (*Carduus lanceolatus* L.)
6. **Wild or Prickly Lettuce** (*Lactuca scariola* L.)
7. **Buffalo Bur,** Beaked Horse-Nettle (*Solanum rostratum* Dunal.)
8. **Perennial Franseria** (*Franseria discolor* Nutt.)
9. Rough Amaranth (*Amaranthus retroflexus* L.)
10. **Pigweeds** Low Amaranth (*Amaranthus blitoides* Wats.)
11. Common Tumbleweed (*Amaranthus albus* L.)
12. **Dandelion** (*Taraxacum officinale* Weber.)
13. **Poverty Weed** (*Iva axillaris* Pursh.)
14. **False Flax** (*Camelina sativa* Crantz.)
    Troublesome in grain, observed but once, Parkman, July, 1896.
15. **Skeleton Weed** (*Lygodesmia juncea* Don.)
    Grain fields and cultivated grounds; perennial, dig it out, common.
16. **Wild Tomato** (*Solanum triflorum* Nutt.)
    Very annoying in gardens and truck patches; annual, prevent seeding.
17. **Dock,** Sour Dock (*Rumex salicifolus* Wienm.)
    In meadows, perennial, hard to eradicate; dig out, prevent seeding.

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*For brief notes upon these and other weedy plants, as to locality, date of collection, etc., see Bull. 28, First Report on the Flora of Wyoming.

18. **Purselane,** Pusley (*Portulaca oleracea* L.)
    Becoming common in rich field and garden soil; Sheridan and Wheatland, July, 1896.

19. **Common Crab Grass,** Polish Millet (*Panicum sanguinale* L.)
    Troublesome in garden crops, perennial; "hit it with a hoe."

20. **Great Ragweed** (*Ambrosia trifida* L.)
    Margins of fields, fence corners and yards, unsightly; mow it.

21. **Mallow** (*Malvastrum coccineum* Gray.)
    Cultivated ground and door yards, perennial; dig it out.

22. **Prickly Pear Cactus** (*Opuntia polyacantha*, several varieties.)
    A nuisance on the range and in pastures; cultivation and water kills it.

23. **Bur Grass,** Sand Bur (*Cenchrus tribuloides* L.)
    Sandy ground; prevent seeding by clean cultivation.

24. **Dodder** (*Cuscuta*, several species.)
    Troublesome in Alfalfa and Flax; remedy, rotation of crops.

25. **Green Fox-Tail** (*Setaria viridis* Beauv.)
    In cultivated grounds; pull up and prevent seeding.

26. **Sunflower** (*Helianthus annuus* L.)
    Waste ground; plow under and prevent seeding.

27. **Cockle Bur** (*Xanthium Canadense* Mill.)
    Cultivated ground, southeastern part of the State, annual; clean cultivation the remedy.

28. **Sow Thistle** (*Sonchus asper* Vill.)
    Reported as spreading at Evanston; prevent seeding.

29. **Yellow Flax** (*Linum rigidum* Pursh.)
    Grain fields; rotation of crops, clean culture.

30. **Hedge Bindweed** (*Convolvulus sepium* L.)
    Still rare, Cheyenne; thorough late cultivation.

31. **Wild Oats** (*Avena fatua* L.)
    Not uncommon in oat fields; clean seed, rotation of crops.

32. **Wild Buckwheat,** Black Bindweed (*Polygonum convolvulus* L.)
    Common in grain fields and truck patches; clean seed and cultivation.

33. **Lamb's Quarters** (*Chenopodium album* L.)
    Common in all cultivated grounds; clean cultivation.

34. **Ragweed,** Roman Wormwood (*Ambrosia artemisiæfolia* L.)
    Laramie, Cheyenne, Sheridan; in grain fields and cultivated ground.
35. **Rib Grass,** English Plaintain (*Plantago lanceolata* L.)
    Reported only from Lander; clean seed and prevention of seeding.
36. **Porcupine Grass** (*Stipa comata* Trin.)
    An annoying and worthless grass.
37. **Poison-Weed,** Larkspur (*Delphinium Geyeri* Greene.)
    Very abundant in places. This is the plant which hungry cattle sometimes eat voraciously, in which case it often causes fatal bloating.
38. **Loco,** Loco-Weed (*Oxytropis Lamberti* and its varieties.)
    Very common, said to cause the peculiar mental disorder in horses known as "loco."
39. **Gum Plant** (*Grindelia squarrosa* Dunal.)
    Troublesome in lawns and meadows; prevent seeding.
40. **Wild Mustard** (*Brassica sinapistrum* Boiss.)
    Only single specimens observed. A bad weed, pull it out.
41. **Shepherd's Purse** (*Capsella Bursa-pastoris* Medic.)
42. **Rocky Mountain Bee-Plant** (*Cleome integrifolia* T. & G.)
43. **Wild Liquorice** (*Glycyrrhiza lepidota* Pursh.)
44. **Stick-Seed** (*Echinospermum Lappula* Lehm)
45. **Goose Grass,** Door Grass (*Polygonum aviculare* L.)
46. **Perennial Ragweed** (*Ambrosia psilostachya* DC.)
47. **Spanish Needles** (*Bidens frondosa* L.)
48. **Marsh Elder** (*Iva xanthifolia* Nutt.)
49. **Pepper Grass** (*Lepidium apetalum* Willd.)
50. **Wormwood Sage** (*Artemisia biennis* Willd.)

Suggested Weed Legislation.

AVEN NELSON.

THE SITUATION IN WYOMING.

Wyoming has a weed law*. Is it effective? Let the facts in regard to the Russian Thistle and other weeds set forth in the preceding pages answer.

Wyoming needs some new weed legislation *now* if it is to be of the greatest possible service to the State. We may need such legislation more some years hence, just as he who is seriously ill needs a physician more than he who has the incipient stages of the malady. Prevention is always better than cure, but when a physician must be called the chances for the patient are better if he be called promptly. Vast sums of money are being expended in other States to cure an evil which is, so to speak, only at our threshold. Prompt action, with the expenditure of only a nominal sum, will do much to protect us against the weed foes which are just beginning to make themselves felt.

The notion has long prevailed that this is a grazing State solely, that the flocks and herds run on the open range, and that these, with the mines of our mountains, constitute our wealth. It is time for such notions to cease. Our agricultural interests have had a marvelous development. In some counties they are paramount, and in all equal to any other single interest.

The open range stock business, with its hazards, is giving place to more conservative methods. Smaller, but more numerous herds, individual rather than company ownership, pastures accessible from the ranch or farm, hay and feed during severe weather, are changes which are placing this interest upon a safe business basis. As this comes to be the status of affairs, farming, with all that that implies, is inseparable from it. Let our mines develop beyond the expectation of the most sanguine, our agricultural interests, in the inclusive sense of the term, must yet be the source of much of our wealth. In this vast empire of 100,000 square miles there are other interests than those of the mines and the old time range stock business. Let him who doubts this visit the different counties, and he will see many prosperous and happy homes on well kept farms. The prosperity of our farmers is inseparable from that of the State Let their interests be conserved by legislation which will not leave them to fight their weed foes unaided. Several lines of railroad are operated within the State, and it is to be hoped that we shall soon have more. Inseparable adjuncts of civilization as they are, they are also, for reasons previously stated, the principal means for the introduction of new weeds into the State. Let it be said, however, to the everlasting credit of railroad corporations, that they have shown themselves more ready to comply with the spirit of weed laws than have many individual citizens. It is hardly to be expected, however, that said corporations will concern themselves with what is never called to their attention.

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*Session Laws of 1895. Russian Thistle and Canadian Thistle are proscribed. No method is provided for bringing this fact before the people or the officers concerned; neither are any means suggested by which these plants may be recognized. The act is printed in full at the close of this bulletin.

The danger points at present are not the ranches and farms, but the right of way of the railroads, our public highways, and especially the vacant grounds in our towns and cities. All of these danger points may be guarded if the matter is officially brought to the notice of the parties concerned.

LEGISLATION.

It may be objected that with so much unoccupied territory weed laws cannot be enforced, but as I have endeavored to show it is not the unoccupied territory that is the source of danger. It is this unoccupied territory, as well as our fields and farms, that we would protect.

No one thinks for a moment that weeds can be legislated out of existence, but there are two or three of foreign introduction that the State as a whole is interested in repressing, and that, by united action, can be kept in subjugation. Grain growing communities cannot afford to admit the Russian Thistle, neither can those who are interested in pasture and range grounds afford to permit its occupancy of these.

A large majority of the States and territories have laws relating to certain weeds. Every year of late sees one or more ot those without such legislation falling into line. No State has ever repealed such legislation except to substitute more timely acts for those repealed. Judging by these facts one infers that such laws have been found profitable elsewhere. This State needs such safeguards more than the compactly settled commonwealths.

Mr. L. H. Dewey, Assistant Botanist to the Department of Agriculture, has for several years been studying the weed question in all of its aspects. The weed legislation of the several States has come in for its share of attention. He has personally investigated the operation of said laws in respect to the objects sought to be attained. After such study of the whole subject he has published*

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*Legislation Against Weeds, Bulletin No. 17, Div. of Bot., U. S. Dept. of Agriculture.

"a form which outlines the essential provisions of a general State weed law."

This form seems to embody all that is practical in this line of legislation, and has received the endorsement of the chief officials of the Department of Agriculture*.

Taking this form as a basis, and modifying it so as to adapt it to the conditions in this State, having respect all the while to the fact that the expenses attendant upon such a law must be reduced to the minimum, the following form is respectfully recommended to the Legislature of this State for its consideration as a substitute for the present law upon the subject†.

AN ACT FOR THE EXTIRPATION OF SUCH WEEDS AS ARE MOST INJURIOUS TO THE AGRICULTURAL INTERESTS OF THE STATE OF WYOMING:

Be it enacted, etc.:

SECTION 1. A permanent commission, to be known as the State Weed Commission, is hereby created, to consist of the Professor of Botany of the University of Wyoming, who shall be known as the State Botanist, and three eminent farmers or ranchmen, who shall be appointed and commissioned by the Governor, with the consent of the Senate, from among the farmers or ranchmen who may be members of the Legislature during the two years following such appointment. They shall hold their offices for a term of two years, or until their successors are appointed. The Governor shall have power to fill all vacancies that may happen in the commission during the recess of the Senate, by granting commissions, which shall expire at its next session‡.

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*I quote from the letter of transmittal of the bulletin cited: "I have pointed out in my annual report for 1894 the fact that, since the total value of our principal field crops for the year 1893 was $1,700,480,271, an increase of only 1 per cent., which might easily have been brought about through the destruction of weeds, would have meant a saving to the farmers of the nation of about $17,000,000 during that year alone. The passage of effective weed laws, like the one outlined and discussed in this report, is of the first importance in dealing with this problem." This letter was signed by Dr. Frederick V. Coville, Chief of the Division of Botany, and directed to the Hon. J. Sterling Morton, Secretary of Agriculture, who undoubtedly approved of the publication of the bulletin under consideration.

†The original form, of which this is largely a copy, "was carefully revised by a jurist familiar with legal usages and constitutional requirements."

‡For full explanation of each of these sections, with reasons for their several provisions, see the bulletin previously cited. The reason for the suggested composition of the commission is as follows: "The technical knowledge of the botanist and the practical knowledge of the farmers on the commission are needed together to decide what ought to be done and what is really practicable."

SEC. 2. Said commission shall meet biennially at the Capitol on the next week day immediately following the adjournment of the Legislature, and shall be in session for a period not exceeding two days; and for such service each commissioner, who is not a salaried officer of the State, shall be entitled to be paid .... dollars a day for each day's actual attendance at the biennial session; said compensation and the necessary expenses of the commission for stationery, printing and postage shall be paid by the State Treasurer out of any moneys in the treasury, not otherwise appropriated, upon vouchers issued by the secretary of the commission and approved by the chairman.

The members of the commission being members of the Legislature, the short session at its close will not impose upon them any serious hardship, and the cost to the State will be only nominal.

SEC. 3. The Governor shall, when necessary, assign a room at the State Capitol for the use of the commission in which to hold its biennial sessions. Three commissioners shall constitute a quorum. The State Botanist shall be custodian of the records, and, when present, be chairman of the commission.

SEC. 4. Said commission, or a majority thereof, shall determine during its first session what species of weeds, not exceeding three in number, are most injurious to the interests of the State, and shall prepare a list thereof, to be known as Schedule A of this act, which shall state the common and technical names of such weeds and the time or times of year at which they can be most advantageously destroyed, and shall contain a concise description of the best economical methods for their destruction. Said schedule may thereafter be modified at any biennial session of the commission by a majority thereof: *Provided,* That not exceeding the above number of species of weeds shall be included in any biennial schedule.

SEC. 5. When, at its first session, or at any biennial session thereafter, the commission shall have adopted a schedule, or shall have modified one previously adopted, as above provided for, it shall be the duty of the chairman to have a sufficient number of copies of this act, with such schedule annexed, printed and distributed by mail in the following manner: One copy to each State, county and township officer, and one copy to each daily and weekly newspaper published within the State; and the schedule so adopted or modified shall be published in the same manner as the public statutes are published.

"The thorough advertisement of weed laws will do much to secure their observation. Unlike criminal laws, which apply chiefly to men who have little respect for right and justice aside from the fear of penalty, the weed laws apply usually to men who obey the laws without compulsion by the courts, and in most cases a knowledge of the law will be sufficient warning to enforce its provisions. Copies should be sent to agricultural and other papers for publication, so as to disseminate a knowledge of its provisions as widely as possible among the people."*

SEC. 6. It shall be the duty of every owner, lessee, or occupier of land in this State, and of every owner, lessee, or occupier of any city, town, or village lot, upon whose land or lot any of the weeds named in the schedule provided for in this act shall be found growing, to destroy the same or cause them to be destroyed at or before the time or times mentioned in said schedule, and in the mode therein described, or in such other manner as shall absolutely prevent the ripening and spread of their seed.

"In nearly all cases the land owner can do this work at much less cost than it can be done by the public authorities, and in arable fields it can usually be done in the ordinary operations of cultivation."

SEC. 7. The city marshal in incorporated towns and cities, and the road supervisor in each county are hereby constituted weed inspectors for towns and cities, and for the county outside of such towns and cities, respectively.

SEC. 8. In case of the neglect or failure of any owner, lessee, or occupier of any land or lot within this State to destroy thereon the weeds mentioned in Schedule A at or before the times mentioned in said schedule, any person owning or having in charge any land or lot within the same township may complain in writing, stating the names of the weeds, the location of the land, and the name of the owner, to the road supervisor or the officer having in charge the highways or streets of the township, city or village within which the weeds complained of are growing. In every such case the complainant shall send with his complaint a written agreement to pay the said highway commissioner or other officer above designated his reasonable expenses incurred in the inspection of the land complained of on which any of the weeds mentioned in the schedule are not found. Upon the receipt of such complaint it shall be the duty of said road commissioner, or other officer, to inspect the land or lots mentioned in the complaint, and if any of the weeds mentioned in Schedule A are found growing thereon he shall notify the owner, lessee, or occupier of the land in writing to destroy them, and if the weeds are not destroyed at the expiration of five days after service of notice, he shall employ such labor as is necessary and enter the lands and destroy in the most practicable and economical manner (or in the manner prescribed in the schedule) all of the weeds mentioned in the schedule that are found growing thereon: *Provided, however,* That in case there is no resident owner, lessee, or agent responsible for the care of the land the service of notice may be omitted.

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* The comments following Sections 5, 6, 10 and 12 are also by Mr. Dewey.

SEC. 9. Each road supervisor or other officer, designated in Section 7, shall make an itemized statement, duly verified by oath or affirmation, of the expenses incurred in inspecting each tract of land or lot on which weeds mentioned in Schedule A were found growing, and of all expenses incurred by him for destroying said weeds, which statement shall contain a description sufficient for identification at the office of the county assessor of each tract of land or lot on which such weeds were destroyed under his direction, together with the name of the owner, lessee, or occupier of said tract of land or lot, and he shall deliver each such statement to the county assessor, and a certified copy thereof to the county clerk. He shall also issue vouchers for himself in inspecting weeds, at the rate of .... dollars per day, and to each laborer employed in destroying weeds at the rate of .... dollars per day, for the time actually employed. These vouchers shall be presented to and audited by the county clerk, who shall indorse thereon the amount he finds due, and then they shall be returned to the payee named therein, or his assigns, or legal representatives, and be paid by the county treasurer out of any moneys not otherwise appropriated, or they shall be receivable for county taxes within the county in which they were issued, to the amounts indorsed thereon by the clerk.

SEC. 10. The county assessor shall assess a special tax on each lot or parcel of land on which weeds have been destroyed by the officers, as above directed, the amount of expenses incurred for inspection and in the destruction of the weeds, as set forth in the verified expense statement received from the inspector. Said taxes shall be collected in the same manner and with like penalties as other county taxes are collected: *Provided, however,* That the owner, lessee, or occupier or any land or lot in respect to which any such expense statement has been issued, may deposit the amount payable thereon with the county treasurer, and in each such case it shall be the duty of the treasurer to receive the same and give notice of the payment to the assessor.

"The expenses of destroying weeds should be paid eventually by the land on which the weeds were destroyed. It would evidently be unjust to pay them from funds raised by the community, and such a method would create a temptation to have one's weeds pulled at the public expense. To assess persons with the costs, or to punish by fine or imprisonment, involves litigation and personal difficulties that often cause the law to be inoperative."

SEC. 11. The State Weed Commission shall have power to prepare and issue all necessary printed forms, notices, and instructions, tending to secure uniformity in employment of labor, statements of expenses, and the rendering of reports.

SEC. 12. Each road supervisor shall, in December of each year, mail to the State Botanist a report in the prescribed form, stating approximately the number of acres in his district on which weeds of each species mentioned in Schedule A were destroyed under his direction during the preceding part of the year, the total cost of destroying them, and the cost of inspecting the land in his district. The State Botanist shall present to the Governor on the first Monday in February in each year, a report of the proceedings of the commission, together with a statement of its expenses, and of the total expenses by counties of inspecting land and destroying the weeds thereon during the preceding year, and of the total number of acres in each county on which weeds have been destroyed as required by this act. And it shall be the duty of the Governor to submit said report to the State Legislature, if then in session, or within the first week of its next regular session.

"A report such as is here proposed will require comparatively little time in compilation, and will aid materially in deciding how much is being done under the law toward the eradication of weeds. It will afford data needed to determine approximately how much the benefits derived from enforcing the law exceed the cost."

SEC. 13. The wilful resistance to, or wrongful interference with any weed inspector or assistant, or laborer employed by any weed inspector, while in the performance of any of the duties in this act prescribed, is hereby declared a misdemeanor, punishable by fine not exceeding .... dollars, or imprisonment not exceeding .... days, or both, in the discretion of the county court, and the county courts are hereby given jurisdiction of all such offences.

SEC. 14. The words, "owner, lessee, or occupier," wherever used in this act, shall include corporations, companies, associations, or agents owning, holding, occupying, or responsible for the use or care of any lot or land within the limits of this State, and they shall be subject to all provisions of this act in the same manner and with like liabilities as any other owner, lessee, or other occupier of lands or lots, and service of notice upon any agent or officer of any such company, corporation, or association shall constitute service upon said company, corporation, or association.

Sec. 15. It shall be the duty of the road supervisor or other officer directly responsible for the care of public highways in each township or county in this State to destroy or cause to be destroyed all weeds mentioned in Schedule A on the highways within his district, at or before the times mentioned in said schedule, and in such manner as to effectually prevent the production of their seeds. He is hereby directed to warn out labor or to employ labor for this purpose in the same manner as for repairs to the highway, and for neglect or failure to perform this work he shall be subject to the same penalties as for the neglect or failure to perform duties pertaining to the repair of highways.

Sec. 16. The State Weed Commission shall prepare a plan for the eradication of weeds mentioned in Schedule A found growing on lands belonging to the State, and also on lands within the State, the title of which still remains in the Federal Government, and shall report the same to the Governor, to be by him transmitted to each branch of the Legislature during the first week of the next regular session of the Legislature.

Sec. 17. The State Botanist shall at least once in every two years visit each county in the State, and personally consult with the inspectors of said county in order that he may inform himself in reference to the status of the law as respects enforcement, and that he may intelligently and from personal knowledge bring before the commission at its next session the further needs of the State in such matters as are entrusted to said commission. His necessary expenses connected with such visitation, and with his attendance upon the biennial session of the commission, shall, upon presentation of a certified voucher, countersigned by the secretary of the commission, be paid by the State Treasurer in the same manner as are the other expenses of the commission.

The suggested bill seems to provide for all that is at present practicable, and if supported by a healthy public sentiment, will meet the necessities of the case. It has one feature that should commend it heartily, viz: its small demands upon the revenues of the State. It involves no expenditures on the part of the State except the necessary expenditures of the commission, which need not exceed a very few hundred dollars for each biennium. The expense of enforcing the law falls finally upon the negligent land owner or corporation, and no opportunity for annoying or expensive litigation seems to be opened up by this law.

OUR WEED LAWS AS AT PRESENT NOMINALLY IN FORCE.

For the information of those of our citizens who may receive this bulletin, a copy of our weed legislation as it now exists is given in full:

Be it enacted by the Legislature of the State of Wyoming:

SECTION 1. It shall be the duty of every person, company, association of persons, railway company, corporation and municipal or public corporation in this State to destroy or cause to be destroyed on all lands or premises owned, leased, occupied, controlled or used by such person, company, association or corporation, and upon all rights of way owned, used or occupied by either of them, the noxious weeds hereinafter mentioned, namely: the *Salsola kali tragus*, commonly known as the Russian Thistle and the Canadian Thistle.

SEC. 2. Each county road supervisor, district road supervisor, and board of the county commissioners in this State is charged with the duty of notifying the owner or occupant of any lands or premises upon which any of the noxious weeds mentioned in Section 1 of this act exist, of the existence thereof on such lands or premises, and the board of the county commissioners of any county may designate any county or district officers within their county, or any suitable person or persons therein, to give such notice, which shall be in such form, of such substance and purport as shall give effectual notice of the existence of the noxious weed or weeds to owner or occupant of the land or premises on which the same exists, and such board may allow such reasonable compensation, not exceeding three dollars per day for each day necessarily and actually employed by such officer or person so designated in the performance of such duty.

SEC. 3. Any person, company, association of persons or corporation mentioned in Section 1 of this act, who shall fail or refuse to destroy or cause to be destroyed any of the noxious weeds mentioned in this act on any lands or premises owned, used, leased, occupied or controlled by such persons, association of persons or corporation, including rights of way used, occupied or controlled by them, or either of them, after knowledge of the existence of any such noxious weeds on such lands or premises, shall be guilty of a misdemeanor, and, upon conviction thereof, shall be fined in any sum not to exceed five dollars for each day that any such noxious weeds shall remain living on the lands or premises owned, used, occupied, leased or controlled by such person, association of persons or corporation after the knowledge of the existence thereof or of notice of the existence thereof. The notice of the existence of any of such noxious weeds may be such as is required to be given by this act, or any notice, either oral or written, given by any person to the owner or occupant of lands or premises upon which such noxious weed or weeds exist, of the existence of the same.

Approved February 26, A. D. 1895.

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Agricultural College Department.

WYOMING EXPERIMENT STATION,

LARAMIE, WYOMING.

BULLETIN NO. 75

JULY, 1907

The Life and Preservation of Pitch Pine Fence Posts.

By B. C. BUFFUM.

Bulletins will be sent free upon request. Address: Director Experiment Station, Laramie, Wyo.

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The Life and Preservation of Pitch Pine Fence Posts.

BY B. C. BUFFUM.

The writer was the first man employed by the Board of Trustees to begin experimental investigations under the provisions of the Hatch Act, in Wyoming. One of the first experiments started was the simple one here reported, to determine the life of our ordinary pitch pine fence posts, and to see if some cheap method of treating could be practiced which would prolong their usefulness. At that time some experiments were being conducted by the railroads in methods of treatment to preserve ties. Attempts had been made in Europe and America to preserve piles driven in the sea, and paving blocks for streets, but so far as we know this is the first fence post preserving experiment inaugurated. Any apparent crudeness in the plan may be excused on this score. The investigation has been brought to a successful conclusion after more than sixteen years of waiting, and it is hoped the results here reported may be of value to some of our readers. The trial was made on the fence extending east and west across the north side of the Experiment Farm.

Since this experiment was begun the Bureau of Forestry of the United States Department of Agriculture has carried out some experiments in cheap methods of treating fence posts. Several pamphlets have been issued and a brief account is given in the year book of the Department for 1903, which contains some information of value. This report makes the general statement that all tar oil products should be applied hot, and that wood which is dry will absorb considerable quantities of such preservatives as tar oil, sperittine, carbolineum, etc. Some instructions are given for treatment of posts by dipping in a solution of corrosive sublimate. The solution should have a strength of one part corrosive sublimate to 150 parts of water. This salt is difficult to dissolve and should first be placed in a small quantity of hot water and then diluted to the required amount. It is very poisonous and must be used with caution. As the salt will decompose by the mercury amalgamating with metal, the solution must be used in wooden, cement, or crockery vessels, and even here it loses its strength with use, or if light reaches it for any length of time, so it must be often renewed and kept covered. The cost of treatment is said to be about four and one-half cents per cubic foot of wood, which makes it a cheap method, and it is claimed to be quite successful, especially where but little water comes in contact with the wood to dissolve the salt. The timbers are soaked long enough to allow the solution to penetrate them effectively.

Other treatments recommended by the Deprtament are soaking in tar oil or in creosote. A cheap process, more generally used than the others, is treating with zinc chloride. This has much practical value, but it is said the salt leaches out rapidly when the wood becomes wet.

In parts of Wyoming crude petroleum is cheap and our experiments here reported indicate that if properly used it is quite effective as a post preservative against dry rot.

PLAN OF THE EXPERIMENT.

From the lot of pitch pine posts bought to fence the forty acres, eighty average posts were selected. I believe that these posts cost fifteen cents each, delivered at the farm. North of the fence and running parallel with it at a distance of four or five feet was a small lateral from the canal, used by the neighbors as an irrigation ditch. South of the line of fence twelve feet of ground was set aside for a road. This was used as an approach to the farm buildings for ten years. South of the road and at a distance of twelve or thirteen feet

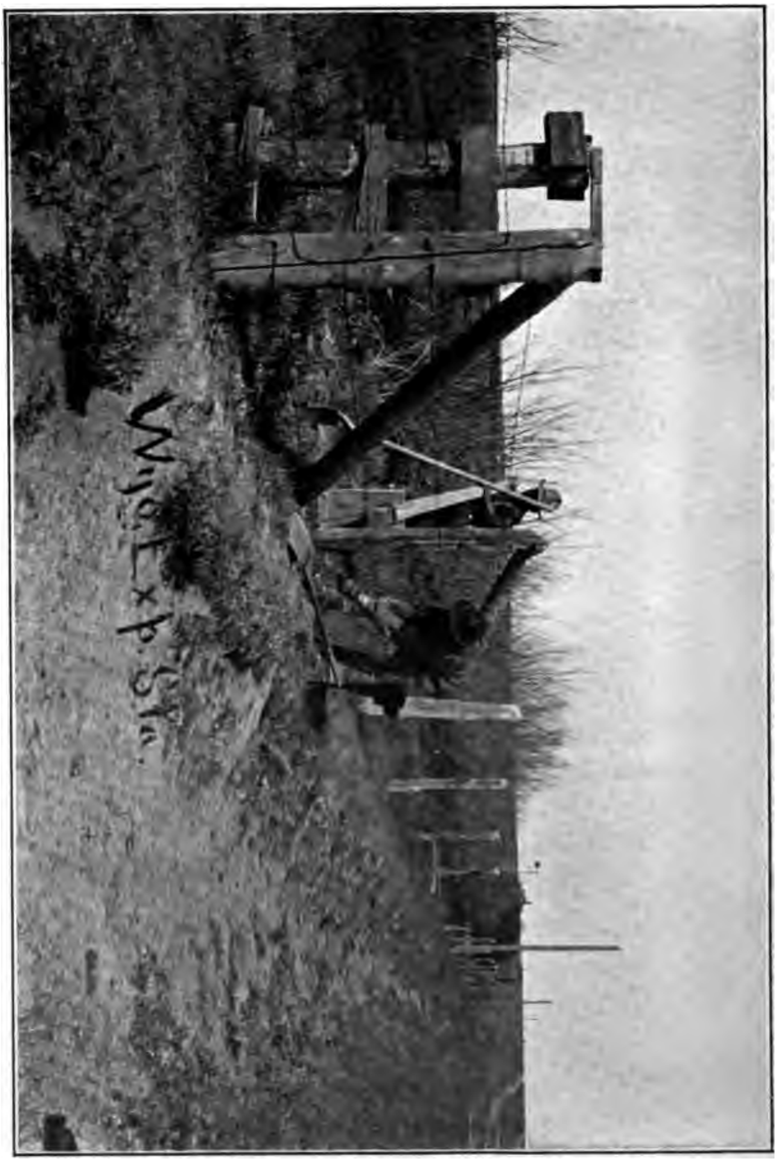


PLATE I. (See description on page 17.)

from the fence was another small irrigation lateral, along which willow cuttings were planted.

These eighty posts were divided into sixteen lots of five each. They were treated and set in the ground at a depth of two feet, one rod apart. The numbering was commenced at the northeast corner of the forty acres, at the first post west of the corner post, and extended from this post toward the west. The corner post was a gate post and was not included in the experiment. The different lots were as follows:

No. 1. Five posts well coated with tar to a distance of two and one-half feet from the bottom of the post.

No. 2. Five good, clean posts, not treated, as a check.

No. 3. Five posts treated with crude oil, or petroleum, two and one-half feet of the bottom of the post.

No. 4. Five posts with a tar band one foot wide, eighteen to thirty inches from the base, to protect the wood near ground surface.

No. 5. Five posts with crude oil band one foot wide, from eighteen to thirty inches from the base.

No. 6. Five posts with crude oil covering two and one-half feet of the bottom of the post, and the oil burned off.

No. 7. Five posts with coating of tar two and one-half feet of the bottom, and the tar burned off.

No. 8. Five posts with band of crude oil one foot wide, from eighteen to thirty inches from the base, and burned off.

No. 9. Five good posts, untreated, as a check.

No. 10. Five posts with tar band one foot wide, eighteen to thirty inches from base, and burned off.

No. 11. Five posts with one foot of bottom dipped in tar.

No. 12. Five posts with one foot of bottom dipped in tar and tar burned off.

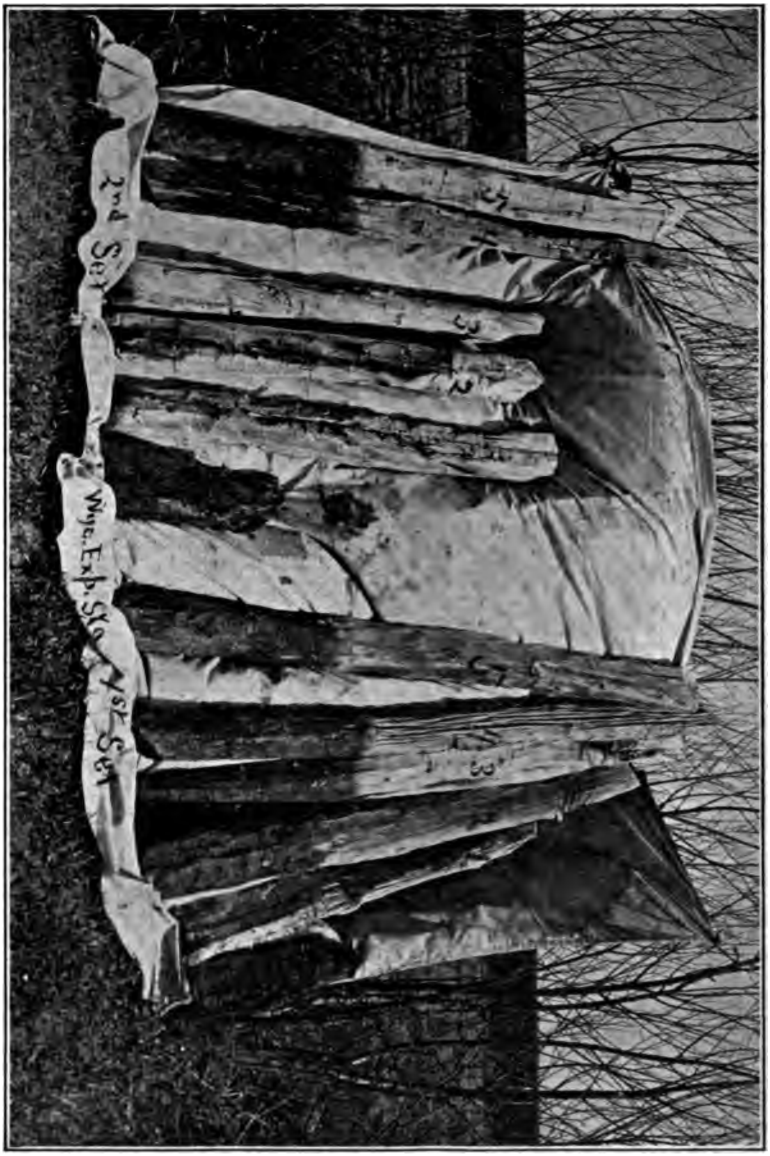


PLATE II. (See description on page 17.)

No. 13. Five of the poorer posts, containing little pitch, untreated.

No. 14. Five good, well charred posts. Two and one-half feet of the bottom of these posts was simply burned to produce a protecting char.

No. 15. Five posts with one foot of bottom dipped in crude oil.

No. 16. Five posts with one foot of bottom dipped in crude oil, and oil burned off.

There was the usual brace at the corners of the fence, and one double brace at the center post. The fence consisted of four ordinary strands of barbed wire with barbs four or five inches apart. The posts were treated and all set on April 15, 1891, and were allowed to stand without disturbing until June 27, 1907, a period of sixteen years, two months and twelve days. During that time accidents happened to only two posts. These were in lot 15. Between them the wire fence was opened near the house, and within the past year two of the posts were broken off by being struck by a wagon as it passed through the gate. One of these was in fairly good condition, being broken off by the force of the blow. The other was partly rotted off with dry rot near the surface of the ground, as indicated in the notes.

RESULTS OF THE EXPERIMENT.

The posts were all dug up in one day, June 27th, and careful notes taken of their condition, and the photographs taken which are here reproduced. The accompanying table gives in condensed form the data of the condition of each set of five posts:

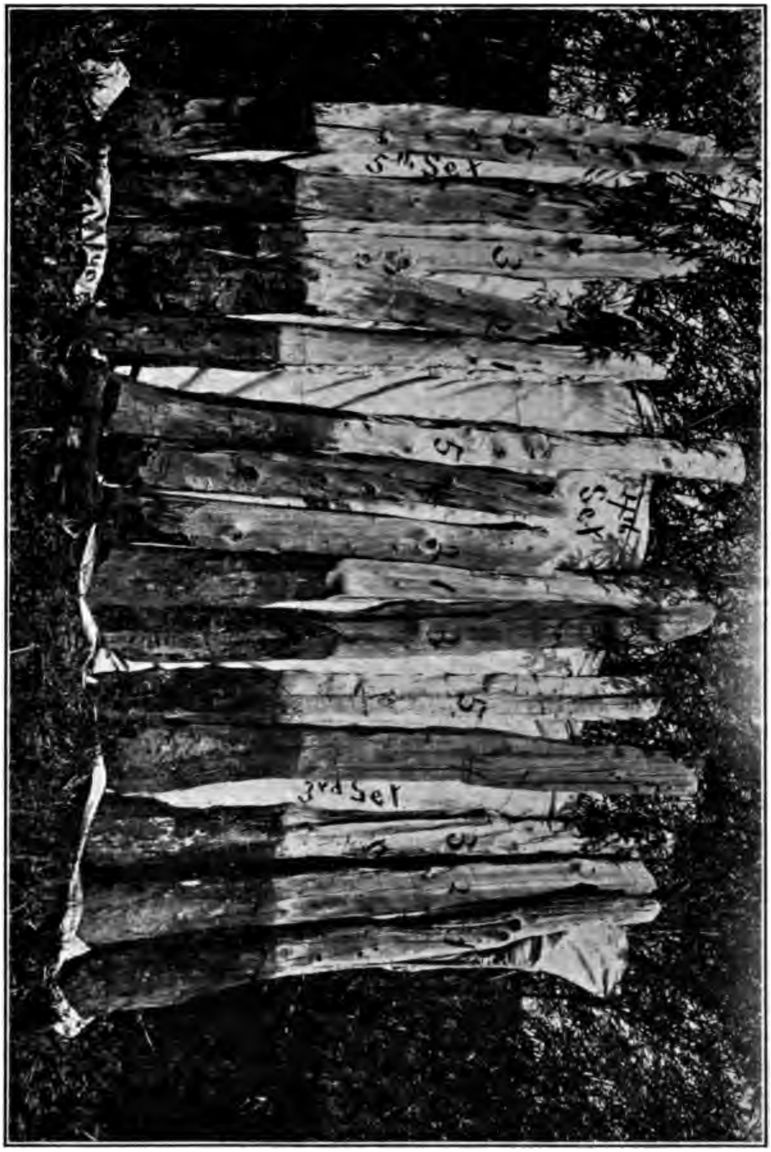


PLATE III. (See description on page 17.)

FENCE POST EXPERIMENT.

No of set	TREATMENT	Number whole	Number broken	Condition at bottom, per cent	Condition at ground surface, per cent	Condition of top, per cent	NOTES
1	Coal tar $2\frac{1}{2}$ ft. bottom			100	65	85	One gone at 15 yrs.; 4 would last 20 or 25 yrs.
2	No treatment	2	3	30	12	85	Three gone at about 12 yrs.; 1 would last 17 yrs; 1, 18 yrs.
3	Crude oil $2\frac{1}{2}$ ft. base		0	95	75	90	Two would last 20 yrs.; 3 perhaps 30 yrs.
4	Tar band 1 ft. wide			75	50	95	Two good as new; 1, 20 yrs.; 2, about 12 yrs.
5	Crude oil band		0	95	90	98	Four good as new; 1 good for 25 yrs.
6	Crude oil and burned			100	98	85	All 5 practically good as new; should last 30 yrs. or more.
7	Tar $2\frac{1}{2}$ ft. and burned			60	50	95	One good as new; 4 would probably last 20 yrs. or more.
8	Crude oil band and burned			60	15	90	One good for 18 yrs.; 3 have been broken 3 or 4 yrs; 1 gone this year.
9	No treatment			40	35	90	One good for 20 or 25 yrs.; 2 gone now; 1, 17 yrs.; 1 off several yrs.
10	Tar band and burned	3		5	40	85	Two good for more than 20 yrs.; 2, 14 yrs.; 1, 16 yrs.
11	Tar 12 in. base			75	50	95	All would probably stand to 25 yrs.
12	Tar 12 in. and burned			50	40	80	Two would last 20 yrs.: 2, 18 yrs.; 1 broken a yr. or more.
13	No treatment	2	3	00	7	80	One might stand 17 yrs.; 2, 16 yrs.; 2, 14 yrs.
14	Well charred			70	95	90	Two, 25 yrs.; 1 broken would have stood 17 yrs.; 2, 20 yrs. or more.
15	Crude oil 12 in. base	2		......	40	90	Two good for 20 yrs.; 1, 16 yrs.; 1, 15 yrs.; 1, 14 yrs.
16	Crude oil 12 in. and burned	2		......	30	90	Two may last to 20 yrs.: 2 gone this year: 1 gone 2 yrs. ago.

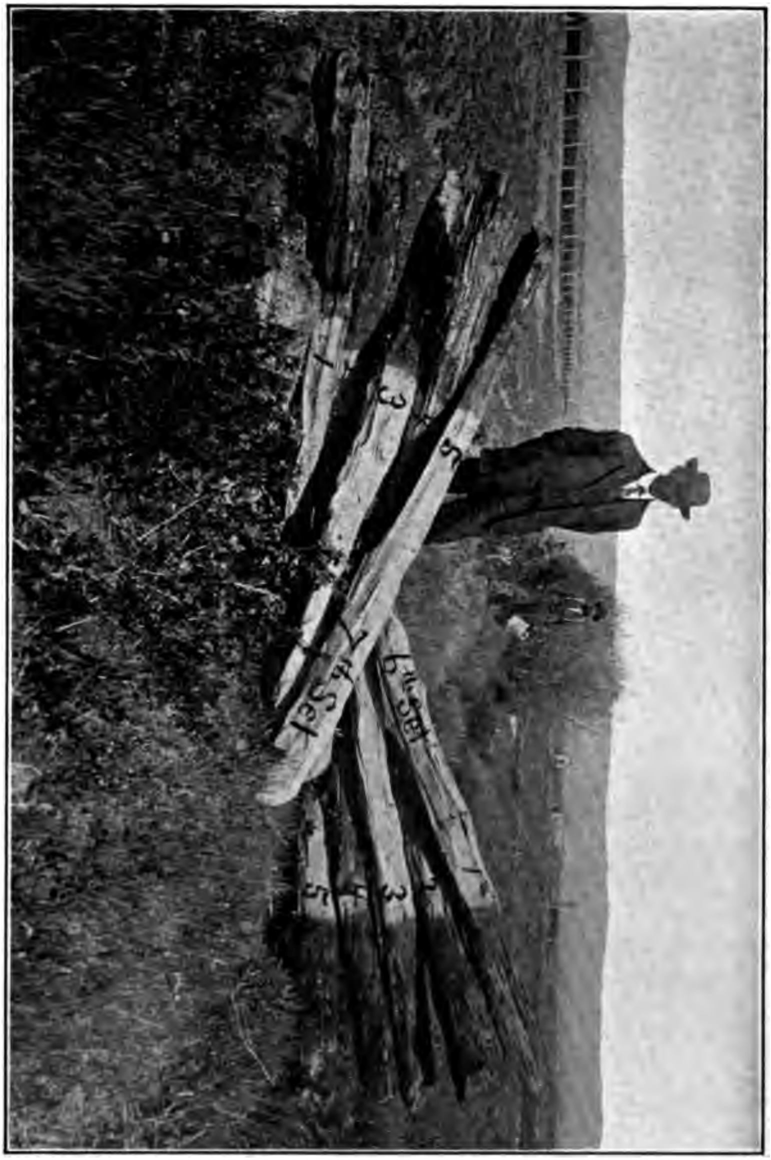


PLATE IV. (See description on page 18.)

FENCE POST EXPERIMENT.

No of set	TREATMENT	Number whole	Number broken	Condition at bottom, per cent	Condition at ground surface, per cent	Condition of top, per cent	NOTES
1	Coal tar $2\frac{1}{2}$ ft. bottom..........	4	1	100	65	85	One gone at 15 yrs.; 4 would last 20 or 25 yrs.
2	No treatment	2	3	30	12	85	Three gone at about 12 yrs.; 1 would last 17 yrs; 1, 18 yrs.
3	Crude oil $2\frac{1}{2}$ ft. base............	5	0	95	75	90	Two would last 20 yrs.; 3 perhaps 30 yrs.
4	Tar band 1 ft. wide.............	3	2	75	50	95	Two good as new; 1, 20 yrs.; 2, about 12 yrs.
5	Crude oil band..................	5	0	95	90	98	Four good as new; 1 good for 25 yrs.
6	Crude oil and burned...........	5	0	100	98	85	All 5 practically good as new; should last 30 yrs. or more.
7	Tar $2\frac{1}{2}$ ft. and burned..........	5	[illegible]	60	50	95	One good as new; 4 would probably last 20 yrs. or more.
8	Crude oil band and burned....	2	[illegible]	60	15	90	One good for 18 yrs.; 3 have been broken 3 or 4 yrs; 1 gone this year.
9	No treatment	4	[illegible]	40	35	90	One good for 20 or 25 yrs.; 2 gone now; 1, 17 yrs.; 1 off several yrs.
10	Tar band and burned...	3	[illegible]	5	40	85	Two good for more than 20 yrs.; 2, 14 yrs.; 1, 16 yrs.
11	Tar 12 in. base..................	[illegible]	[illegible]	75	50	95	All would probably stand to 25 yrs.
12	Tar 12 in. and burned..........	4	[illegible]	50	40	80	Two would last 20 yrs.; 2, 18 yrs.; 1 broken a yr. or more.
13	No treatment	[illegible]	[illegible]	00	7	80	One might stand 17 yrs.; 2, 16 yrs.; 2, 14 yrs.
14	Well charred	[illegible]	[illegible]	70	95	90	Two, 25 yrs.; 1 broken would have stood 17 yrs.; 2, 20 yrs. or more.
15	Crude oil 12 in. base............	2	[illegible]	......	40	90	Two good for 20 yrs.; 1, 16 yrs.; 1, 15 yrs.; 1, 14 yrs.
16	Crude oil 12 in. and burned....	2	[illegible]	......	30	90	Two may last to 20 yrs.; 2 gone this year; 1 gone 2 yrs. ago.

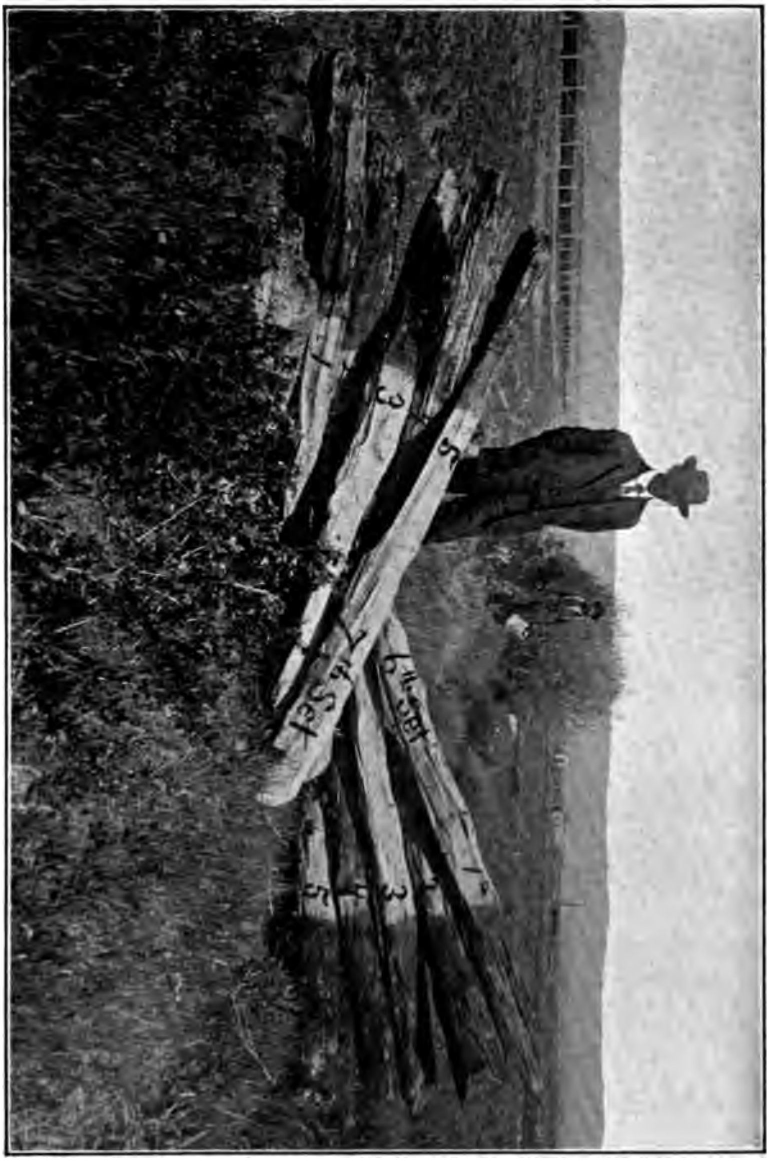


PLATE IV. (See description on page 18.)

Column 1 is the number of the set; column 2 states briefly the treatment; column 3 gives the number of posts which are whole, that is, have not been broken off through action of dry rot; column 4 gives the number which have been broken off; and from the appearance some estimation was made of the length of time these posts have been standing in the fence with the bottoms rotted off. The last three columns of the table give the condition of the posts at the bottom, at the ground surface, and weathering at the top, giving it in percentage. If the post was in perfect condition the mark will be 100 per cent; if entirely rotted off, so it would stand no longer in the fence, the percentage will be 0; if the estimation showed 50 per cent gone with dry rot, the condition would be 50 per cent, and so on. These figures give a comparative idea of the effects of different methods of treatment and of the life of the posts not treated. In the notes following each set of data in the tables an attempt is made to estimate the life of each post. In the cases where they have probably been rotted off for one or more years, the notes indicate that the life of the post was that much less than the length of time since the experiment was begun. On the other hand, if in the opinion of the observer the post would last a longer time, the total life of the post is indicated. For example, in the fourth set of posts it is estimated that one would last four years longer, and the notes state "one 20 years," indicating that the total life of the post would be 20 years. Two of these posts had been rotted off for four or five years, and the notes state that their life was about twelve years. In addition to the tabulated data, the following notes on each post are given to indicate the general condition:

NOTES.

First 5. Two and one-half feet of bottom dipped in tar. Post No. 1 rotted off near surface of the ground, about two feet two inches from the bottom. Bottom in good condition, showing no rot. Posts Nos. 2, 3, 4, and 5, all in fairly good

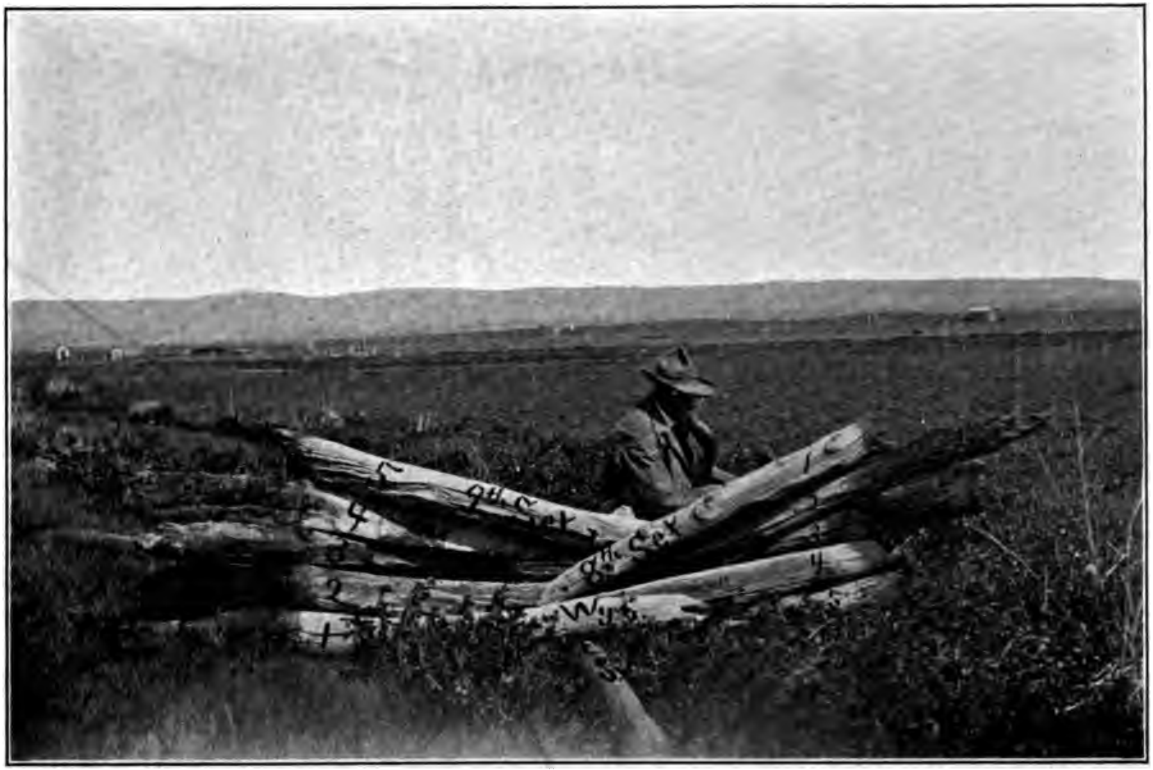


PLATE V. (See description on page 18.)

condition; each one is just beginning to show the effects of dry rot in a ring from twenty-two to twenty-seven inches from the bottom, which is the location of the surface of the ground.

Second 5. No treatment. Posts Nos. 1, 2, and 3 rotted off near the surface of the ground. No. 4 effected with dry rot from within six inches of the bottom to the ground surface, and would probably not last more than one year longer. Post No. 5 badly dry rotted from the bottom to the ground surface. Only No. 5, in this set, still holding the fence.

Third 5. Two and one-half feet of base dipped in crude oil. Post No. 1 showing a little dry rot from bottom to surface, increasing till about 10 per cent of the body of the post is affected at the ground surface. Posts Nos. 2 and 3 sound at bottom, but about 10 per cent of the body of post rotted off with dry rot in a ring eight to ten inches wide near the ground surface. Posts 4 and 5 practically in a perfect condition.

Fourth 5. Treated with tar band eighteen to thirty inches from base. Posts No. 1 and No. 5 in perfect condition. Posts Nos. 2 and 4 rotted squarely off near the ground surface. Post No. 3 dry rotted from bottom of post to above ground surface, about two-thirds gone.

Fifth 5. Band of petroleum eighteen to thirty inches from base. Post No. 1 almost in perfect condition, enough rot started to be noticed. Post No. 2 beginning to dry rot near surface of the ground; would probably last seven to ten years longer. Posts Nos. 3, 4, and 5 almost as good as new.

Sixth 5. *Crude oil two and one-half feet of base, burned off. Posts almost as good as new. No. 1 shows slight beginning of rot underneath the char, but the others are in perfect condition. If properly done, this treatment seemingly would make good posts last indefinitely.*

Seventh 5. Tarred two and one-half feet of base, and tar burned off. Post No. 1, one-half body of post rotted off near

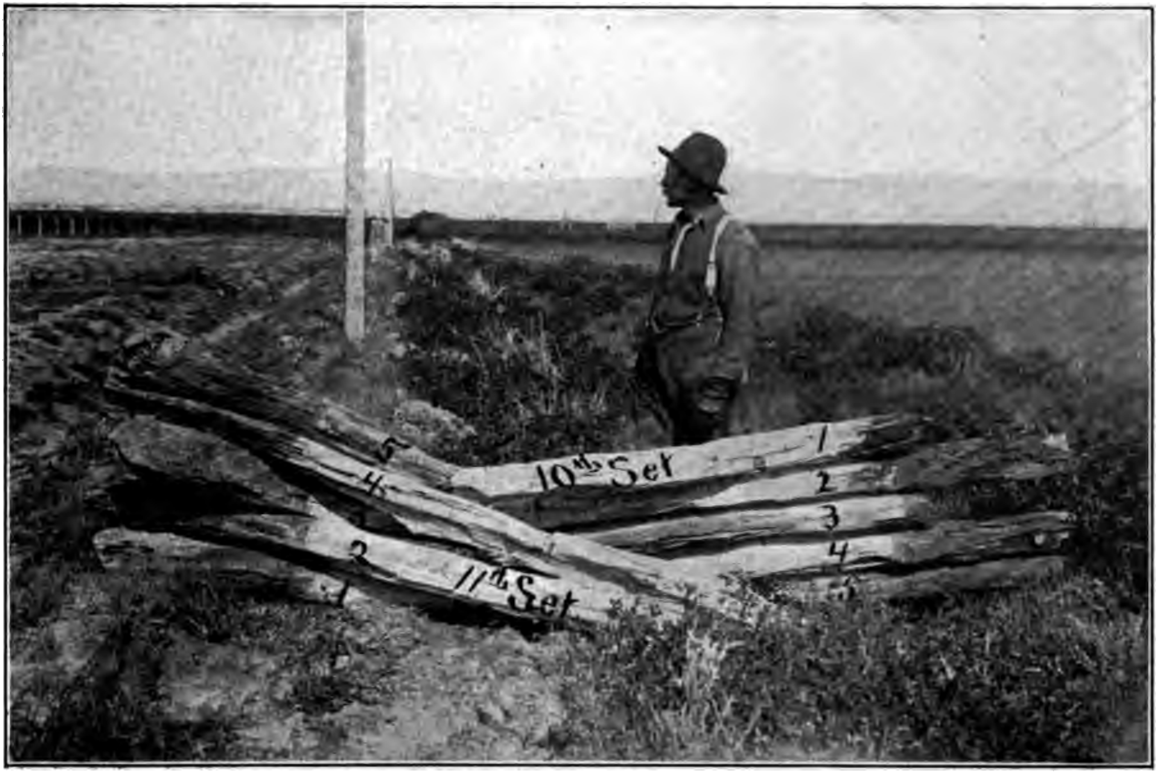


PLATE VI. (See description on page 18.)

ground surface. Post No. 2, good as new. Post No. 3 about one-third rotted off near ground surface. Post No. 4 shows general dry rot from bottom to the surface of the ground. Post No. 5, general dry rot from bottom to the surface of the ground.

Eighth 5. Crude oil band eighteen to thirty inches from bottom, burned off. Posts Nos. 1, 4, and 5 rotted through and broken squarely off an inch or two below the surface of the ground. Nos. 2 and 3, dry rotted from bottom to the surface, and near ground surface one-third to three-fourths gone.

Ninth 5. No treatment. Posts Nos. 1 and 3 show a little dry rot from the bottom to the ground surface. Posts Nos. 2 and 4, rotted three-fourths off. Post No. 5, rotted and broken squarely off at ground surface; apparently has been in this condition for several years.

Tenth 5. Tar band eighteen to thirty inches from bottom and burned off. Posts Nos. 1 and 3 rotted squarely off near surface. Post No. 4, four-fifths gone. Posts Nos. 1 and 5, dry rotted at the bottom, No. 5 being in fair condition near the surface of the ground.

Eleventh 5. Tar twelve inches of base. All five posts show very uniform condition, each being rotted about the same amount from the bottom of the post to the ground surface. This rotting is not large in amount, the maximum being about one-fourth of substance of post.

Twelfth 5. Tar twelve inches of the base and burned off. Post No. 1 in good condition, showing a little dry rot. Post No. 2, all of the part under ground effected with dry rot, being one-half to two-thirds gone. Posts Nos. 3 and 4, from one-fifth to two-thirds rotted away. Post No. 5, rotted and broken squarely off near the ground surface.

Thirteenth 5. No treatment. Post No. 1 rotted and broken off ten inches below the surface. Post No. 2, one-fourth rotted off. Posts Nos. 3 and 4, rotted and broken squarely off

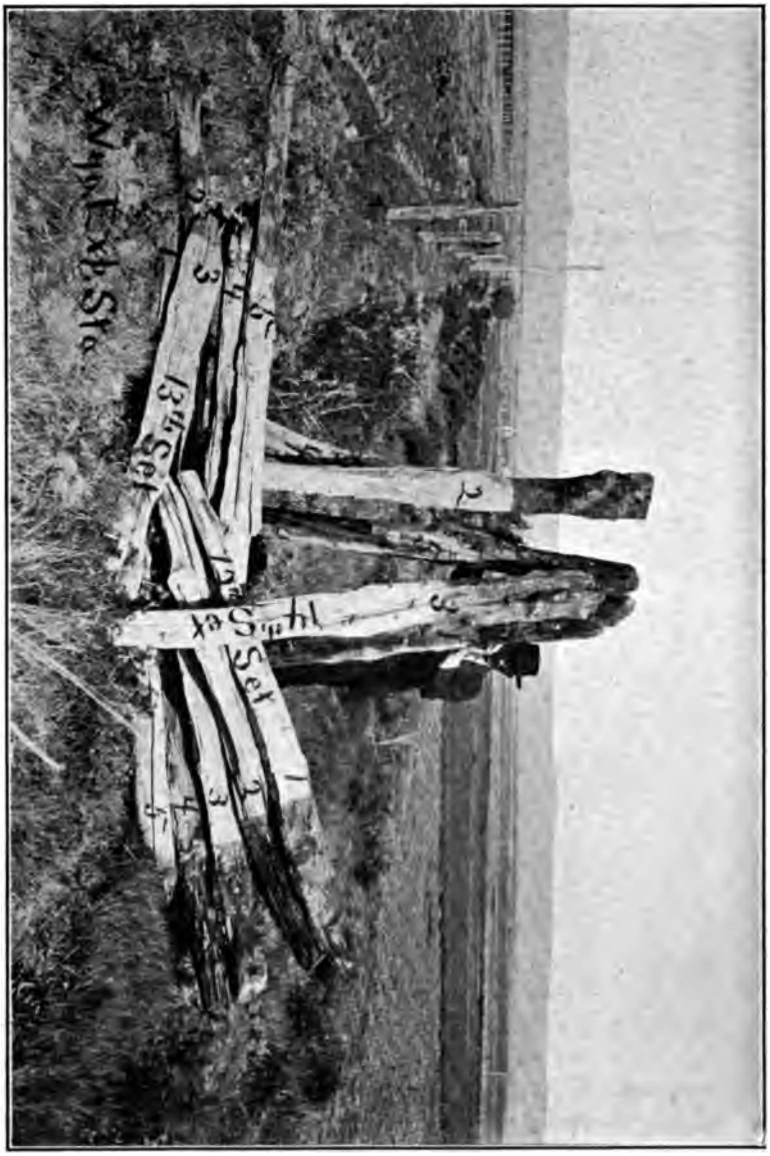


PLATE VII. (See description on page 18.)

six inches below the surface. Post No. 5, rotted almost through from the surface to the bottom of the post; might last one year longer.

Fourteenth 5. Well charred. Posts Nos. 1 and 2 in fairly good condition, merely showing beginning of rot near the surface. Post No. 3 in good condition. Post No. 4 rotted and broken off one foot below the surface. Post No. 5 shows dry rot from the surface of the ground to the bottom of the post.

Fifteenth 5. Twelve inches of the base dipped in crude oil. Post No. 1, broken off and exchanged last year, was partly destroyed with rot. Post No. 2, broken off this year by accident, was in good condition. Post No. 3 rotted off at surface and changed last year. Post No. 4 in good condition. Post No. 5 rotted off five or six inches below the surface of the ground.

Sixteenth 5. Twelve inches of the base dipped in crude oil, and oil burned. Posts Nos. 1 and 2, dry rot beginning to show near the surface; in fair condition. Posts Nos. 3 and 4, on each side of canal, rotted off about one foot below the surface, or just above where the oil was burned off. Post No. 5, rotted off at surface.

SUMMARY OF RESULTS.

The best treatment, and one which was eminently successful in preserving the posts, was dipping the lower ends in crude petroleum and burning off the oil a sufficient distance to come above the ground when set. This seems to drive hot oil into the post, which with the protecting char cover keeps it from decay. The sixteen years had made but slight inroads on the posts thus treated, and they apparently would last indefinitely. This dipping can be done very cheaply, and will undoubtedly pay.

Simply dipping two and one-half feet of the bottom of the posts in crude oil or in tar did fairly well. The oil seemed a better protection to the posts than did the coal tar. Posts that were well charred by burning came in about third place.

Under our conditions good pitch pine posts, without treatment, will last from twelve to twenty-five years after being set in the ground.

There is little advantage to be gained by simply oiling or tarring a band to protect the post from dry rot where it comes through the ground, and less from any treatment of only a portion below the ground. Such oil band helped preserve the post, but the time taken to apply the oil in this manner would make it more expensive than dipping the entire lower end of the post.

EXPLANATION OF PLATES.

All made from photographs taken June 27, 1907. The posts were set in the ground April 15, 1891, having been treated two or three days before.

PLATE I. Showing the north line of fence looking west from the northeast corner. The men are preparing to pull up post No. 1, which was broken off a few inches below the ground surface. In the second set of five posts, which was the first check untreated, it will be noticed that the first two posts are broken off and lying on the ground.

PLATE II. This shows appearance of the first and second sets of five posts. Each individual post is numbered from one to five in each set and this number corresponds to the same number in the notes. First set, tar coat two and one-half feet of base, one post rotted off. Second set, not treated, three posts rotted off.

PLATE III. Set three, two and one-half feet of the base dipped in crude oil. None broken. Fourth set, tar band eighteen to thirty inches from base. Posts 2 and 4 rotted off.

Fifth set, petroleum band eighteen to thirty inches from base, all in fairly good condition.

PLATE IV. Sixth set, treated with crude oil two and one-half feet from base and oil burned off. All in good condition, and would last indefinitely. Seventh set, tar two and one-half feet of base and tar burned off. None broken, but posts 1, 3, 4, and 5, affected with dry rot, have seen their best days.

PLATE V. Eighth set (to the right), crude oil band eighteen to thirty inches from base, and oil burned off. This treatment did no good, as three posts were rotted off, and the other two nearly gone. Ninth set (to the left), no treatment. Post No. 5 rotted off. Nos. 2 and 4 practically gone, and the others beginning to decay.

PLATE VI. Tenth set (to the right), tar band eighteen to thirty inches from base and tar burned off. Treatment no value, as only one post, No. 5, is in even fair condition. Nos. 1 and 3 broken off and 2 nearly gone. Eleventh set, tar twelve inches of base. All of the posts beginning to dry rot. None broken.

PLATE VII. Twelfth set (to right), tar twelve inches of base and tar burned off. No. 1 in good condition, others all decayed; from one-half to two-thirds gone. Thirteenth set (to left), no treatment. Three posts rotted off, other two almost gone with decay. Fourteenth set (standing in center), treated by burning two and one-half feet of the base until well charred. Posts 1 and 2 just beginning to show decay. No. 3 in good condition. No. 4 rotted off one foot below the surface of the ground. No. 5 shows some decay.

BULLETIN NO. 112 JANUARY, 1917

UNIVERSITY OF WYOMING

AGRICULTURAL EXPERIMENT STATION

LARAMIE, WYOMING

The Poisonous Properties of the Two-Grooved Milk Vetch

(Astragalus bisulcatus)

By O. A. BEATH and E. H. LEHNERT

Bulletins will be sent free upon request
Address: Director Experiment Station, Laramie, Wyoming

SUMMARY.

I. Milk vetch has been proved to be poisonous to cattle. Suspicion is held regarding its effect upon sheep.

II. Eighty to ninety per cent of the animals affected die.

III. Water easily removes the active poison from green or air-dried material.

IV. All parts of the plant contain poison with a slight excess in the leaves.

V. The poison is neither precipitated by basic acetate of lead nor decomposed at the boiling point of water.

VI. It can be deprived of its toxicity by boiling with dilute acids (indicating its probable glucosidic character).

VII. The poison is non-alkaloidal.

VIII. A definite crystalline substance has been isolated, giving chemical reactions common to glucosides.

IX. Thus far no chemical antidote has been obtained.

X. As indicated by the physiological action of the poison, drugs that stimulate the heart and nervous system should prove beneficial in the case of vetch-poisoning.

The Poisonous Properties of the Two-Grooved Milk Vetch

(Astragalus bisulcatus)

PART I. CHEMICAL.

BY O. A. BEATH.

INTRODUCTION.

A brief account of the two-grooved milk vetch (*Astragalus bisulcatus*) is put in the form of a preliminary bulletin at this time, largely to warn stockmen of its poisonous nature. Authorities on poisonous plants make no mention of this particular vetch as being suspected of producing toxic effects. As a consequence it is safe to conclude that certain conditions undoubtedly prevail which cause it to be extremely variable in its toxicity. Moisture unquestionably influences the activity of the toxic principle, inasmuch as it is readily soluble in water. Certain stockmen have used this vetch for forage purposes without any apparent ill effects, thereby illustrating the small degree of danger when the plant is well dried.

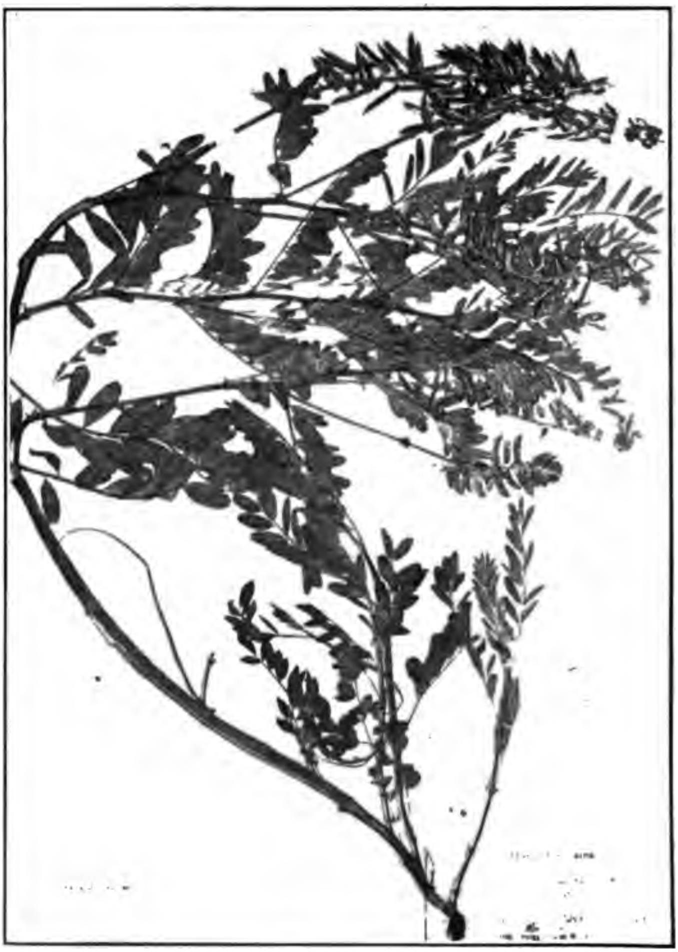
The attention of the research laboratory was called to the plant's probable poisonous character rather late in the season and as a result the data available at this time have to do only with well matured material. Therefore, the seasonal factor is yet to be determined.

It is a matter of regret that direct feeding experiments could not have been employed to verify the results obtained by using water and alcoholic extracts. However, the project is to be continued on a larger scale this coming summer.

GENERAL CHARACTER OF THE PLANT.

Milk vetch is found growing on plains and in valleys throughout the Rocky Mountain region. It appears during the month of May and goes to seed the latter part of July. The following description of the plant is given in Bulletin No. 76 of the Wyoming Experiment Station:

This is one of the large, coarse vetches, usually growing in dense clumps and becoming 2 to 3 feet high. It produces purple blossoms in profusion and these are followed by an abundance of pods from one-half to nearly an inch long and having two rather deep furrows on the upper side. The plant is rather rank scented, especially when young, and, unless other forage is scarce, is not browsed down until the pods begin to mature.



The Two-Grooved Milk Vetch.

All parts of the plant contain poison apparently quite evenly distributed throughout.

Data gathered from stockmen would indicate that this species of vetch is poisonous to cattle and sheep. Nothing is known in regard to its effect on horses. The laboratory has obtained no direct evidence that sheep have been killed by eating it, although a number of suspicious cases are on record.

During July, 1916, E. B. Foster of Casper reported a loss of nine calves and ten cows out of a herd of forty-one head. He states, "No two acted in the same way. However, all evidenced signs of craziness. On some the effect would hardly be noticed until one went near them, and then they would suddenly act frightened and in attempting to get away would stumble and fall or have a fit." All animals which showed signs of milk-vetch poisoning died.

EXPERIMENTAL.

The plant material submitted for investigation was secured from Mr. Foster of Casper, Wyo. Green plants could have been obtained in the vicinity of Laramie, but it seemed advisable to deal with those authentically known to have given trouble.

After drying, the seeds, pods, leaves, and stems, respectively, were coarsely ground and placed in air-tight containers.

Test for Hydrocyanic Acid.

Five hundred grams of air-dried material were placed in a flask and saturated with water. Steam was then passed into the flask for a period of three hours. The distillate gave negative results for hydrocyanic acid. Tests were made upon each part of the plant. The residue remaining in each case was acidified with strong sulphuric acid and again treated as above. Negative results were obtained for combined hydrocyanic acid.

The distillates had an odor particularly disagreeable. The distillate from the seeds yielded a small amount of volatile oil which proved to be non-toxic in character.

Test for Active Enzymes.

One hundred grams of finely ground leaves and stems were digested with three liters of water at a temperature of 37.5° C. for a period of 48 hours. The aqueous portion was separated and mixed with an excess of alcohol. A profuse precipitate was formed which soon settled to the bottom of the flask. The alcohol was removed and the solids remaining were washed with a little cold alcohol and subsequently dried. A portion added to a dilute solution of amygdalin failed to produce hydrolyses to any appreciable extent. This indicates the absence of *Beta*-glucose or allied enzymes capable of hydrolyzing *Beta*-methyl glucosides. Not having any representative of the *Alpha*-methyl glucosides the presence of *Alpha*-glucose could not be ascertained.

Water Extracts.

In carrying out the work of determining the character of milk vetch it was quickly demonstrated that water was a better solvent for the removal of the poisonous principle than alcohol, ether, chloroform, or acidulated water.

The concentrated water extracts were invariably dark, resembling plant resins obtained by alcoholic percolation. Residues obtained by alcoholic treatment were dark and in general did not differ in appearance from those derived by maceration with water. If to a concentrated alcoholic extract a large volume of water was added, a bulky grayish precipitate was thrown down. This, upon closer examination, proved to be calcium sulphate.

With the exception of three extracts, all were given internally to full-grown rabbits. The three administered otherwise were given to an old ewe, a yearling calf, and a female dog.

The extracts used in the tests were prepared as follows:

No. 1.

Seeds and pods (dry)	3 oz.
Alcohol (95%)	10 oz.

Mixture digested 24 hours at a temperature of 37.5° C., concentrated to small bulk and diluted with 2 oz. of water.

No. 2.

Leaves (dry)	3 oz.
Alcohol (95%)	10 oz.

Treated the same as No. 1.

No. 3.

Seeds and pods (dry)	3 oz.
Water	15 oz.

Digested for 24 hours at 37.5° C. Aqueous portion separated and concentrated to 2 oz.

No. 4.

Leaves and stems (dry)	46 oz.
Water	350 oz.

Same treatment as No. 3, concentrated to 75 oz.

No. 5.

Stems (dry)	6 oz.
Water	12 oz.

Treated as in No. 3, concentrated to 5 oz.

No. 6.

Leaves and stems (dry)	87 oz.
Water	150 oz.

Same treatment as in No. 3, concentrated to 25 oz.

No. 7.

Whole plant (dry)	22 oz.
Water	150 oz.

Digested 48 hours at 37.5° C. Aqueous portion separated and concentrated to 25 oz. Treated with slight excess of basic lead acetate. Lead precipitate removed, washed, and suspended in large volume of water. Lead precipitated as lead sulphide. Remaining solution concentrated to 5 oz. Labeled Solution "A".

That portion of the original water extract not precipitated by basic lead acetate was treated with hydrogen sulphide to remove lead and concentrated to a volume of 5 oz. Labeled Solution "B".

No. 8.

Leaves, stems, and pods (dry)	3 oz.
Water	10 oz.

Digested 48 hours at the boiling point of water. Filtered. Concentrated to 2 oz.

No. 9.

Leaves, stems, and pods (dry)	3 oz.
Water	10 oz.
Sulphuric acid (5%)	1 oz.

Digested 48 hours at 90° C. Filtered. Sulphuric acid removed. Solution concentrated to 2 oz.

Results as to Activity of Extracts.

Extract No. 1. Volume, 2 oz.

Given internally to full-grown rabbit at 11 a. m. No symptoms at 5 p. m. Died during the night.

Extract No. 2. Volume, 2 oz.

Given to full-grown rabbit at 11 a. m. No symptoms at 5 p. m. Died during the night.

Extract No. 3. Volume, 2 oz.

Given internally to full-grown rabbit at 11 a. m. Decided symptoms at 1:30 p. m. Restoratives administered. Died at 6 p. m.

Extract No. 4. Volume, 75 oz.

Given by drench to an old ewe October 4, at 2:45 p. m. No symptoms indicated.

Extract No. 5. Volume, 5 oz.

Given by drench to dog at 10 a. m. Decided symptoms of nausea at 10:30 a. m. The dog vomited repeatedly with marked straining. In a few hours the symptoms disappeared.

Extract No. 6. Volume, 25 oz.

Given to yearling calf October 31, at 11 a. m. No symptoms observed until the following day, at 9:45. Animal was unable to rise, and had a temperature of 94.5° F., pulse 74, respiration 12. Died at 2 p. m., November 1.

Extract No. 7. Volume, 5 oz.

Solution "A" given to full-grown rabbit at 1 p. m. Died at 6 p. m. Solution "B" given to rabbit at 1:30 p. m. No indications of poisoning.

Extract No. 8. Volume, 2 oz.

Given internally to full-grown rabbit at 11 a. m. At 1 p. m. the usual symptoms were observed, such as non-co-ordinated movements and loss of control. Rabbit died at 4 p. m.

Extract No. 9. Volume, 2 oz.

Given internally to full-grown rabbit at 11 a. m. No symptoms indicated.

Conclusions.

1. The data so far obtained indicate that a definite active poison is present.

2. In no case did a rabbit live when given freshly prepared extracts.

3. Although the old ewe showed no effects from a dose of extractive material equivalent to fifteen pounds of the green plant, yet it is not safe to presume from this experiment that the vetch is not poisonous to sheep, for (1) only one sheep was tested and (2) green plants may produce an effect different from that of the extract of the dried ones.

4. On account of the ease with which a dog can empty its stomach by vomiting when irritants are given, we have concluded that in our experiment with the dog not enough of the poison was absorbed to manifest itself.

FUTURE WORK.

Having studied the general nature of the active poison, our next step will be to conduct feeding experiments, typifying range conditions as far as possible, and to study the problem of milk vetch poisoning from the point of view of symptoms and specific antidotes.

No. 8.

Leaves, stems, and pods (dry)	3 oz.
Water	10 oz.

Digested 48 hours at the boiling point of water. Filtered. Concentrated to 2 oz.

No. 9.

Leaves, stems, and pods (dry)	3 oz.
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PART II. PHYSIOLOGICAL.

BY E. H. LEHNERT.

How the Poison Acts.

From experiments carried on with extracts and other preparations from this plant, our observations both before and after death have led to a few definite conclusions. When sufficient poison to cause death is introduced into the system, whether through the stomach or intravenously, it acts quickly, that is it is quickly absorbed, and very soon produces symptoms of paralysis, by its action on the nervous system; the action of the heart is also interfered with, and the poison no doubt kills by acting on this organ. When the poison is administered by the stomach, postmortem examination shows that digestion is stopped immediately, as invariably this organ remains full of food, indicating that the poison is quickly absorbed from the stomach and that the stomach is paralyzed.

Remedies and Methods of Treatment.

Attempts at determining an antidote for the poison were made, and, although few in number, certain conclusions have been reached. Thus far no chemical antidote has been obtained, but from the obvious action of the poison on the heart and nervous system as a depressant, antidotes of a physiological nature would be those that stimulate these organs, such as alcohol, ammonia, strychnine, nitro-glycerine, and digitalis, belladonna or atropine. In our experiments we were able to counteract the poison for a considerable time, although in no case were we able entirely to neutralize its action. It appears, however, very probable that the remedies mentioned should prove very valuable where the amount of poison taken into the system is not too great.

In the administration of remedies in case of poisoning, the following doses and methods would apply: Immediately give to full-grown animal (cow), as a drench, 1 to 2 lbs. of

Epsom salts, dissolved in water; vary dose with size, as in all cases the doses given are for mature animals.

Alcohol should be administered in the form of whiskey, brandy, or gin, in 2 to 4-oz. doses, diluted with an equal quantity of water, the dose repeated every hour.

Aromatic Spirits of Ammonia is one of the best quick-acting heart stimulants, and should be given once an hour in two-ounce doses, diluted with three volumes of water.

Belladonna fluid extract may be used as a heart and nerve stimulant in hourly doses of 2 drachms in a little water. This drug would work well combined with either whiskey or aromatic ammonia.

Digitalis. The tincture digitalis may be given, diluted with water, in 2 to 3 drachm doses every 3 to 4 hours.

For quick action, drugs should be administered hypodermatically, that is, injected under the skin. For this purpose the drugs are very concentrated and put up in tablet form, very soluble in water, and should be administered with the hypodermatic syringe, of which there are many varieties on the market at prices from $2.00 up. For hypodermatic uses in poisoning by vetch, I would suggest a compound tablet consisting of strychnine, nitro-glycerine, and digitalin or atropine, the quantity of strychnine being not over 2 grains; the quantities of other ingredients will not matter materially, as the compounders put them up in the right proportion to give best results. In using the hypodermatic remedy alone, it should be administered once an hour, using clean boiled water to dissolve the tablet, and disinfecting the skin at the point of puncture with any common disinfectant or tincture of iodine. In the majority of cases the worst stages should be over in 3 to 4 hours, and if the vital organs can be kept active during this period, recovery is possible.

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BULLETIN No. 120 JUNE, 1919

UNIVERSITY OF WYOMING

AGRICULTURAL EXPERIMENT STATION

A Common Occurrence in Larkspur Areas.

The Chemical Examination of Three Species of Larkspurs

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The Chemical Examination of Three Species of Larkspurs

Delphinium barbeyi.
Delphinium glaucescens.
Delphinium geyeri.

O. A. BEATH.

PART I

GENERAL

Introduction.

The subject matter in this bulletin is confined to general methods employed in the larkspur investigation, supplemented with such data as seemed advisable to give an intelligent understanding of the facts. The technical phases have been purposely omitted and will be published shortly in a scientific journal. Briefly, these omissions include: The micro-photographic structure of the leaf, flower, and stem of each species; measurement of alkaloidal crystals; ultimate composition of alkaloids; comparative physiological data of individual alkaloids; and the analysis of resinous bodies.

Distribution of Larkspurs.

The classification of the Delphiniums is in a rather unsettled condition and consequently one is reluctant to speak in regard to their distribution. In general, they may be roughly divided into two groups, the tall and low. The tall larkspurs included in this investigation are known provisionally as *Delphinium glaucescens* Rybd., *Delphinium barbeyi* Huth., and *Delphinium geyeri* Greene, the latter being selected as representative larkspur of Wyoming. These three species (Plates I, II, and III) clearly represent distinctive altitudes and habitats.

Delphinium glaucescens is found in the shaded areas of canyons and mountain sides at elevations varying from 6,000 to

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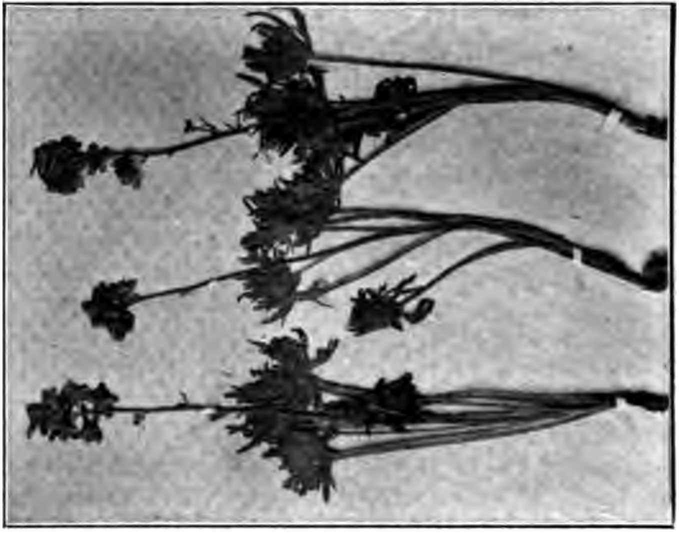

Plate II. Delphinium geyeri Greene.

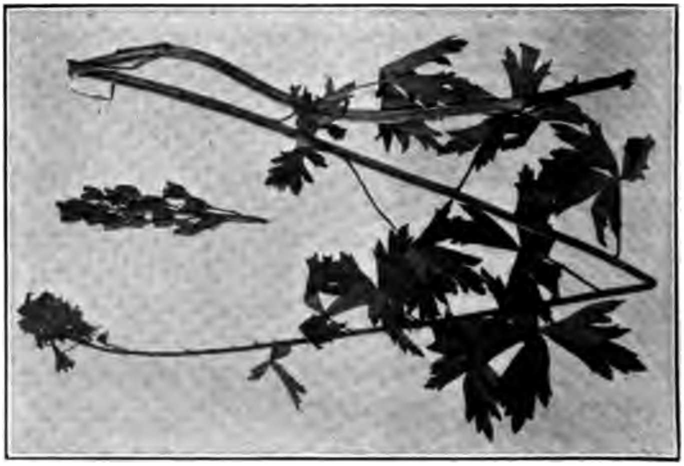

Plate I. Delphinium barbeyi Huth.

9,000 feet. It occurs in Wyoming, Montana, and Idaho, and possibly to some extent in adjacent States. The plant usually appears, especially at lower altitudes, the latter part of May and is in full bloom by the first of July. On account of its habitat, the plant remains thrifty until fully matured. Plate IV shows the characteristic foliage when about one-fourth developed. *D. glaucescens* does not grow in so dense a clump as the other two species.

Delphinium barbeyi grows at altitudes ranging from 8,000 to 11,000 feet. The plant is found in the mountains of Colorado, Wyoming, and Utah, and to the south and north in adjoining States. Its most favorable habitat is in open draws and mountain parks (Plate V), although occasional patches are found partially shaded. The clumpy growth (Plate VI) is similar to that of the low larkspur *(D. geyeri)*. *D. barbeyi* is normally one to two feet in height by the end of June and is in full bloom by the middle of July. The exact time of flowering varies naturally with the season and the altitude.

Delphinium geyeri grows on the plains and foothills of Wyoming, Colorado, and Montana. It appears as a rule early in May and under normal conditions of development is in full bloom by the middle of June. As in the case of the other larkspurs, the season and altitude greatly modify its growth. Plate VII illustrates the plant about three weeks after its first appearance. Plate VIII pictures a larkspur area showing the relative size and amount of low larkspur as compared with the surrounding vegetation. The green, tender plants offer inviting inducements to cattle, especially if the season is dry. After the flowering stage the plant dries up rapidly and disappears from the range. Occasionally severe dry weather interferes with its development and consequently that portion of the plant above the ground dries up prematurely.

Review of Literature.

The poisonous properties of *Delphinium geyeri* and *Delphinium barbeyi* have been definitely determined by many investigators. While *Delphinium glaucescens* is widely distributed, no mention is made in literature of its poisonous nature. The first published statement of cattle poisoning by *D. geyeri* was made by

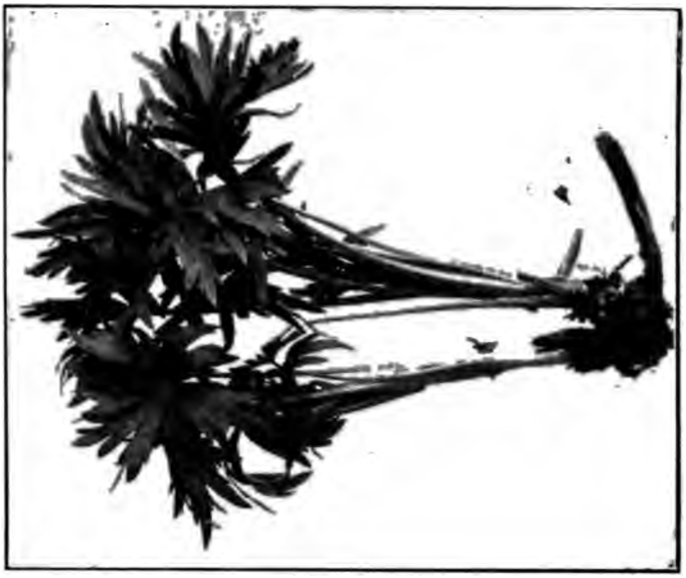

Plate IV. Delphinium glaucescens Rydb., Before Flowering.

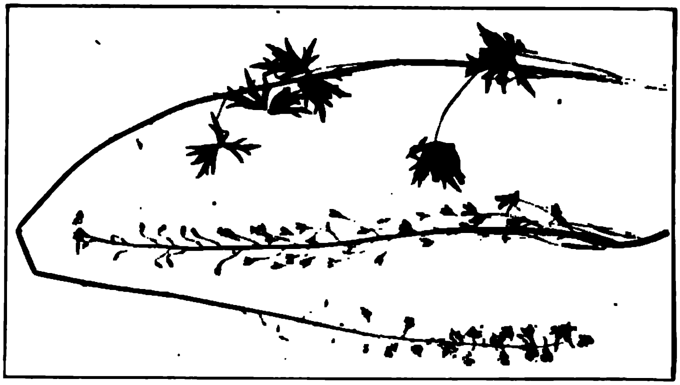

Plate III. Delphinium glaucescens Rydb.

A. Nelson in 1896. He states that "the plant is frequently eaten by hungry cattle with fatal results caused by bloating." Chesnut, in his three publications of 1898, mentions *D. geyeri* as poisonous to stock.

In 1899 Wilcox investigated the tall larkspurs of Montana as to occurrence, period of activity, and approximate losses incurred. He states that most of the trouble was found in the spring after late snow storms.

Chesnut and Wilcox published in 1901 a bulletin dealing with the stock poisoning plants of Montana. The authors discuss in considerable detail *D. glaucum** as a poisonous plant and give data resulting from the experimental feeding of rabbits and sheep. Water and alcoholic extracts, and the expressed juice of undeveloped plants gave positive results.

Glover, 1906, mentions *D. geyeri* as one of five species of larkspurs abundant in Colorado.

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In 1913 the Bureau of Plant Industry published Farmers' Bulletin 531, entitled "Larkspur" or "Poison Weed", which gives some of the practical results of feeding experiments. Three years later the same bureau issued a comprehensive bulletin, dealing with "Larkspur Poisoning of Live Stock". The authors, Marsh and Clawson, selected representative poisonous species of larkspur for their investigation. The report, in addition to clearing up many contradictory points, describes in detail the symptoms of poisoning and resulting pathological conditions. Suggestive remedial measures are given which have proved to be positive in their action.

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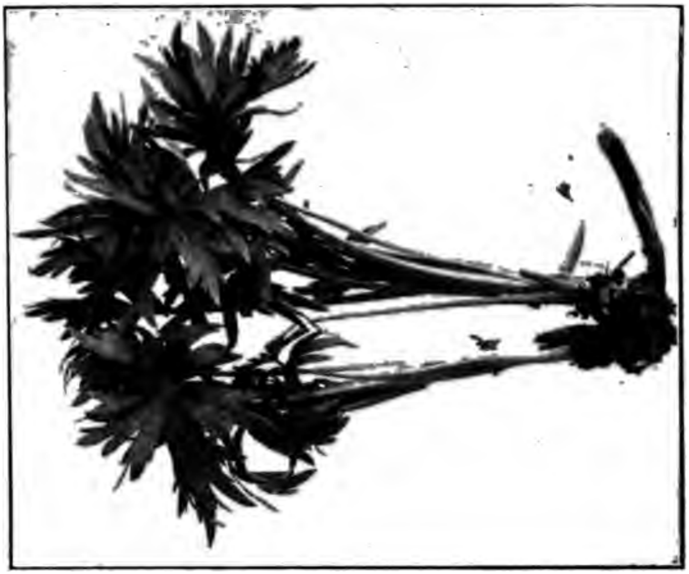

Plate IV. Delphinium glaucescens Rydb., Before Flowering.

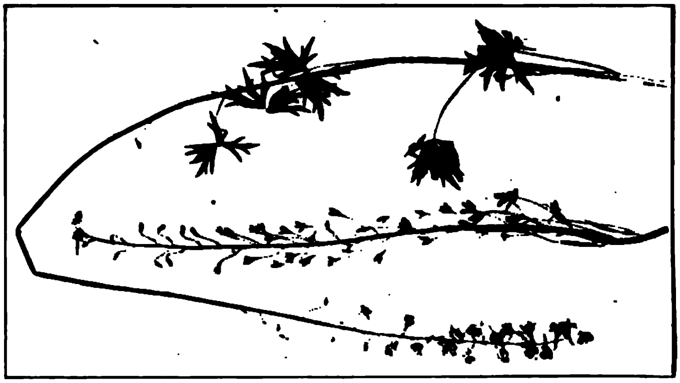

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Plate V. Tall Larkspur (**Delphinium barbeyi Huth.**) in Full Bloom.

Plate VI. **Delphinium barbeyi Huth., Before Flowering.**

The U. S. D. A. Bulletin No. 575 illustrates by means of colored plates the principal larkspurs and, in addition, gives such information as will be helpful in recognizing other plants and the best methods of handling stock in poisonous areas.

The chemical study of the American Delphiniums has not been extensive. Seeds from several European larkspurs have been analyzed and found to contain several alkaloids. Seeds from *D. stapisagria* contain four alkaloids, the most characteristic and important alkaloids being delphinin and stapisagrin. Of these two, delphinin is the more powerful drug. Dr. J. Katz in a comprehensive paper read before the society of German Naturalists and Physicians (Sept., 1900), after discussing the history of delphinin, first prepared by Brandes in 1819, and the other alkaloids of *D. stapisagria,* describes the difficulties experienced by him in the preparation of the pure alkaloid and the method by which he eventually overcame them. The author added potassium sulphocyanide to the acid solution of the crude alkaloid, not as a precipitant of the alkaloids, however, but as a precipitant of the associated coloring matter and impurities. The sulphate, hydrochloride, hydrobromide, acetate, and oxalate salts were prepared, none of which were crystallizable from their water alcohol, methyl alcohol, acetone, or chloroform solutions. The platinochloride salt of delphinin was precipitated in crystalline form. The formula of the pure alkaloid is not given. Hydrolytic experiments, although incomplete, seems to indicate that delphinin partakes of the nature of a compound ether, benzoic acid being split off both from its acid and alkaline solutions.

The physiological action of delphinin has been studied by many authorities with varying results. However, the principal symptoms are in close agreement. The muscular tremblings which start in the abdominal muscles and pass over the body appear to be characteristic of larkspur poisoning. Some writers have compared delphinin to veratrin, some with curare, while most of them compare it with its nearly related relative, aconitine. In regard to the latter relationship, the principal difference seems to be that delphinin has a direct depressing action on the vasomotor centers of the cord (Boehm and Serck) and that the heart muscles are not paralyzed to any extent.

The important symptoms of delphinin are summed up by Hahn (1822) as follows: "The delphinin, after having caused a local irritation, which is not very intense in the first stages, manifests its action on the respiration (slowing of the respiratory movements, death by asphyxiation), on the organs of circulation (slowing of the beatings of the heart, lowering of the blood pressure, stopping of the heart in diastole), on the spinal cord (loss of the excito-motor power of the spinal cord, rapidly progressive general anesthesia, convulsions and paralysis); moreover, the muscles are the seat of intense fibrillar shocks. In its toxic effects delphinin then very much resembles the alkaloids of aconite, as one would expect from the botanical relationships; it is distinguished by its energetic action on the nerves supplying the muscles, an action which aconitine does not possess except in a feeble degree."

Plate VII. **Delphinium geyeri** Greene Before Flowering

O'Keller (1910), contrary to the experience of Masing, who isolated a base, calcatrippine, from the flowers of *Delphinium consolida*, finds these flowers to contain no alkaloid. The seeds of the plant, however, yield three alkaloids. One of these crystallizes from alcohol in thick tablets melting at 195-197° C., but it readily becomes decomposed on further treatment to a transparent mass. Crystalline salts have not been prepared. Another alkaloid is amorphous and almost insoluble in ether. The third alkaloid, also amorphous, is readily soluble in that solvent. The crystalline base

Plate VIII. A Characteristic Patch of Low Larkspur (**Delphinium geyeri Greene**).

is not identical with Merck's pure crystalline delphinin, which is separable by recrystallizaton from alcohol into six-sided tablets melting at 187.5° C., and into pointed aggregated needles which have no sharp melting point, yet fuse at a higher temperature than the tablets.

In 1913 Volker and Keller reported several alkaloids occurring in the seeds of *D. ajacis*, two of which, ajacine and ajaconine, were obtained crystalline. Ajacine, $C_{15}H_{21}NO_4+H_2O$, crystallizes in needles melting at 142-143° C. It is readily soluble in alcohol, chloroform, benzol, petroleum-ether, and acetone; less soluble in ether; slightly soluble in water. The solutions have an alkaline reaction. The salts are reported to be much more soluble in water than the base but do not easily crystallize. The sulphate crystallizes best from an excess of acid. The provisional formula given by the authors is $C_{15}H_{21}NO_4+H_2SO_4$. Ajaconine, to which the formula $C_{17}H_{20}NO_2$ is temporarily given, crystallizes in anhydrous, well formed, colorless, shining prisms melting at 162-163° C. It appears to be a secondary base and forms a dibenzoyl product. It also gives an Iodymethylate crystallizing in fine needles melting at 121° C.

Heyl, Loy, and Hepner, 1913, made a report in regard to the chemical study of several species of Wyoming larkspurs. Mention is made of *D. glaucum*,* *D. nelsonii*, and *D. geyeri*. They state of these three species, that apparently *D. geyeri* is the most poisonous. In addition to determining the quantity of crude alkaloid in each of the species, one alkaloid in an impure condition was isolated.

In summing up the results obtained from laboratory and field investigations, it is apparent that the Delphiniums contain toxic principles similar in nature to the alkaloid delphinin which is, in its action, very much like aconitine, the main alkaloid of the aconites.

Losses from the Larkspurs.

D. barbeyi and *D. geyeri* cause heavy losses to cattlemen annually. *D. glaucescens* is not toxic enough to cause any harm unless eaten in unusually large amounts. On account of the plant's peculiar location, it naturally is not frequented by cattle to any great extent. The writer's statement of losses is confined to cattle, inasmuch as feeding tests, field observations, and reliable data from other sources point to the fact that horses and sheep are not likely to be affected, the former seldom eat it and the latter, for some apparent physiological reason, are able to eliminate the poisons before it is absorbed in sufficient quantities to produce intoxication.

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*Same plant as designated in this bulletin as **Delphinium barbeyi Huth.**

In looking over the grazing records of the Medicine Bow National Forest, I find that on several occasions sheep losses have been reported in certain larkspur areas. In 1912 Ranger Wills reports that the Dana Meadows Sheep Company lost thirty-five sheep from the tall larkspur, *D. barbeyi.* The plants were immature. A review of the flora prevalent in this same area leads me to believe that, in all probability, aconite was the real cause. This plant is so nearly like the tall larkspur in appearance that it might easily be confused with it. Ranger Mann, who has been connected with the Forest Reserve for several years, states that sheep eat the tall larkspur in large quantities without any ill effects. The fact that the reserve carries approximately 60,000 sheep without serious losses from poisonous plants would indicate that the tall larkspurs are harmless.

An effort has been made from reports that have been sent in from various sources to get an approximate percentage of cattle losses. We find such a wide margin of opinions that any attempt to state a definite estimate would be largely presumptious. To quote from U. S. D. A. Bulletin 365, the authors, Marsh and Clawson, state that "A considerable number of persons reporting make an estimate of five per cent. This is a very heavy toll to take from the stockmen, and it is probable that with the exception of the losses from loco poisoning, there is no one cause or loss that draws upon the herds so heavily as larkspur poisoning."

Reports indicating approximate losses are extremely difficult to obtain in Wyoming and especially those resulting from poisonous plants. A few concrete cases collected by the writer will perhaps give a more definite idea what this loss means in individual cases: Mr. J. Coughlin, Mill Creek, Wyoming, reports that in 1889, on a patch of young low larkspur at the head of Mill

Creek, out of a thousand head of cattle, thirty died within a few hours. The Wallace Live Stock Company and others, Millbrook, Wyoming, in trailing cattle from the plains to the Forest Reserve, frequently lose animals from larkspur poisoning. In 1914, during the early part of July, on the plains west of Laramie one could count forty-four dead cattle within a comparatively small area. It can be readily seen that the aggregate loss from this source must be very large.

TOXICITY AS EFFECTED BY AGE OF PLANTS.

Contributing Factors.

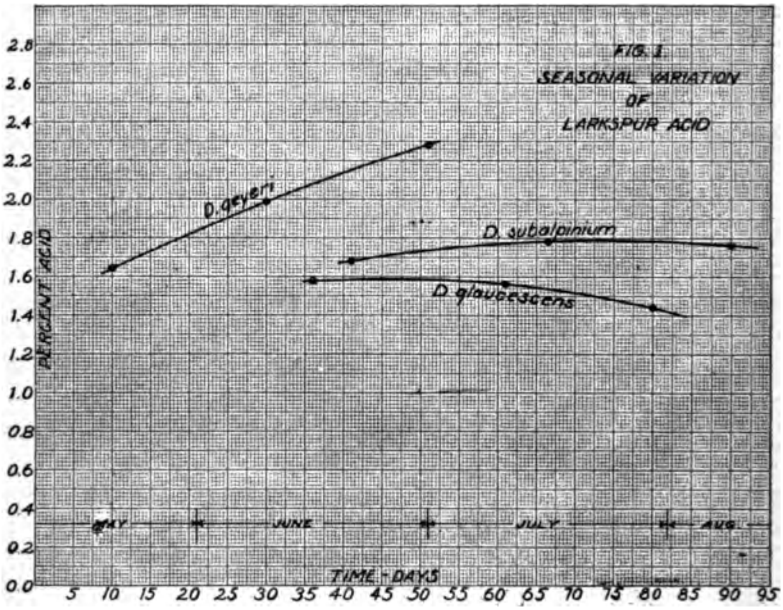
The larkspurs as a group are regarded as particularly dangerous in their early development. Quite apart from the poisonous properties of the plants themselves, it is to be noted that the condition of the range and the physical status of the animals have an important bearing upon the final outcome.

The statement has been made that the larkspurs appear to be more poisonous certain years than others, but after checking over a number of analyses, for similar stages of growth, we do not find any marked variation from year to year. Since a prolonged dry spell reduces the available forage, it naturally follows that cattle will be tempted to eat plants that ordinarily are not touched. Consequently, under these conditions, the conclusion is erroneously drawn that the plants are more poisonous.

The moisture content of the young plants is much higher than that present in the later stages of growth. The species vary to some extent, the plains type being somewhat lower than the tall larkspur. The stems of *D. barbeyi* gathered when the plant was only a few inches in height gave 92 per cent moisture, the leaves for the same period, 84 per cent. *D. geyeri* and *D. barbeyi* each contain a water soluble poison and it seems reasonable to assume that the young plants would yield sufficient moisture to allow, perhaps, more rapid absorption than the more woody fibers.

Acidity of Plants.

During the investigation of the more poisonous species of larkspurs, it was observed that the principal poison was amorphous. Further study brought out the fact that this product could be resolved into two constituents—a crystallizable alkaloid and a water soluble acid. Inasmuch as a direct relationship was found to exist between the acid and the main poison, it was considered advisable to determine any apparent correlation existing between the seasonal variation of the acid and the quantity of alkaloid. Figure 1 illustrates in a general way the seasonal distribution of the free acid. It is clear that, in the early periods of development, the relative quantity of acid is quite uniform for the three types. At the time *D. geyeri* is in full bloom the free acid content is comparatively high, while that of the other two species remains quite constant throughout the life of the plants. It does not appear, therefore, that the amount of free acid in any way correlates with the fluctuation of the quantity of poison. The relationship of the alkaloids delphinin, and aconitine, have been referred to; it may be that the larkspur acid, which is similar to aconitic acid, is the factor vitally concerned in these two alkaloids.



Inasmuch as D. Barbeyi Huth. is generally accepted as representing the principal species of the tall larkspurs in the Rocky Mountain region, it has been referred to in this bulletin in place of D. subalpinium A. Nels. [D. subalpinum].

Seasonal Toxicity of Poisons.

From a study of range poisoning, the conclusion was drawn that the immature plants were responsible for the greater number of losses. In attempting to explain the reason for this common observation, an experiment was completed which had to do with the isolation of the crude alkaloids at different periods of growth and the injecting of these substances, when made up to known dilutions, into full grown rabbits. Figure 2 is a graphic illustration of the quantity necessary to kill (lethal), and to produce symptoms (toxic). *D. geyeri* and *D. glaucescens* show practically the same result, that is, the same weight of crude poison at the time of flowering is just as active as that derived from the young plants. *D. glaucescens,* however, is much less poisonous. In the case of *D. barbeyi,* it is noted that the lethal dose at the mature period is somewhat smaller than that of the immature plants. The seeds have about the same potency as the crude poisons extracted from the plants in bloom. The apparent deviation of the tall larkspur from the other two species in the matter of toxicity at the flowering period will be discussed later on in this bulletin.

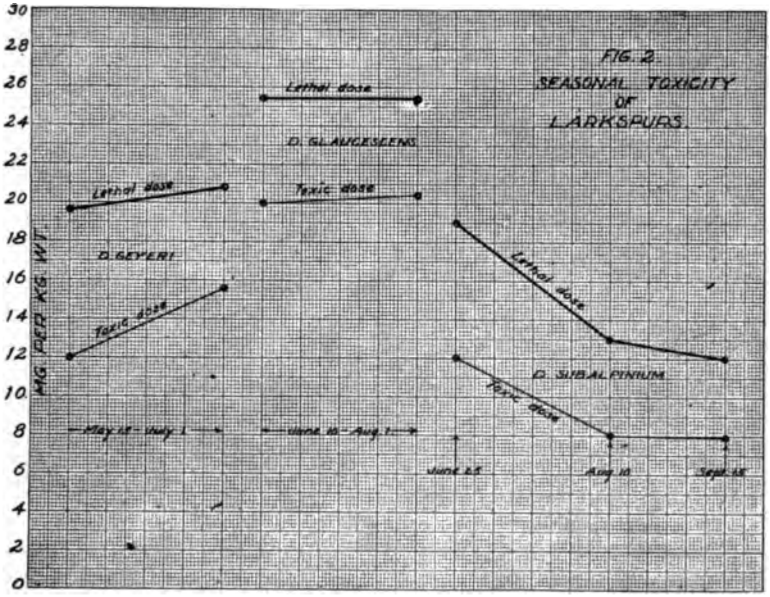


FIG. 2.
SEASONAL TOXICITY OF LARKSPURS.

Seasonal Variation of Poisons.

The negative evidence, with respect to the crude alkaloids losing their activity with the advance of growth, resulted in outlining an experiment which was aimed to determine the relative quantity of poison at distinct periods of development. Figure 3 illustrates very clearly the general trend of the alkaloidal variation found in one season's growth. It will be noted that the three species conform to the same fluctuation, differing only in degree. The seeds of *D. geyeri* were not available. The mature pods of *D. barbeyi* and *D. glaucescens* contain only a trace of alkaloid. As a rule the lowest alkaloidal content is reached when the plants are in full bloom. From this point on to the seeding stage the percentage of poison in the leaves and stems decreases while that in the seeds increases appreciably.

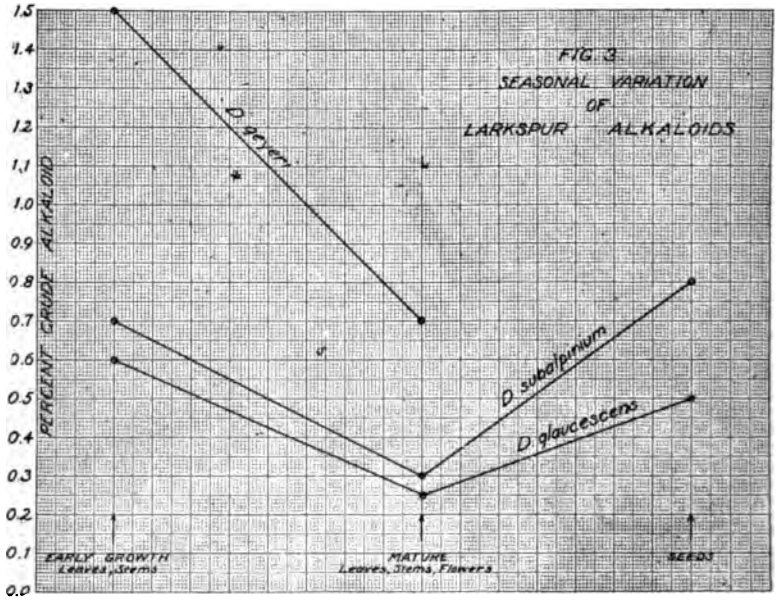


FIG. 3
SEASONAL VARIATION
OF
LARKSPUR ALKALOIDS

We may conclude from these experiments that *D. geyeri* and *D. barbeyi* are dangerous plants from the time of appearance until fully developed. The higher death rate caused by immature larkspurs is very probably due to the relative high alkaloidal content of the young plants. Marsh and Clawson, Bulletin 365, p. 75, state that "If an average curve were made for the charts of *D. barbeyi* Huth. feeding in 1909, 1910, and 1911 it would be found that the quantity necessary to produce poisoning increases progressively from the first of the season until the time when the seeds are formed in the plants. It is a striking fact that the smallest quantity needed to produce poisoning was in the earliest stages". A careful observation of conditions during the past five years in this section of the state, where *D. geyeri* grows abundantly, shows a gradual decrease in losses with the advance in the growth of the plant. Plate IX is a photograph taken on the Laramie Plains July 3, 1917. The writer counted thirty-seven dead cattle within a radius of six miles, which had died from *D. geyeri* poisoning. The plants were in full bloom.

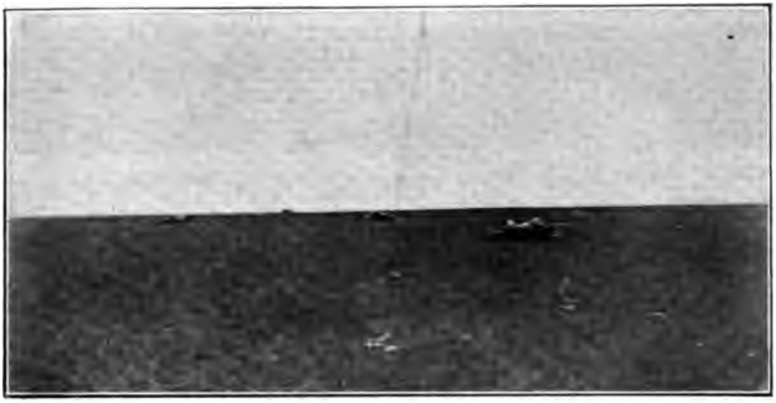


Plate IX. Poisoned by Low Larkspur (Delphinium geyeri). Plants Were in Full Bloom.

Characteristic Symptoms.

Naturally, the initial indications of poisoning vary considerably, depending upon the influence of several factors, particularly the amount of material eaten. Usually the first pronounced abnormal condition noted is the inability to walk naturally. An animal staggers more or less with the hind legs spread somewhat widely apart as though bracing itself against falling. If the poison has gotten into the system in a sufficient quantity, after moving a short distance, the animal falls. In some cases, and especially in acute stages, an animal will drop down very suddenly, the legs appearing to crumple up. Plate X illustrates the position usually taken. In this instance the animals were poisoned by *D. geyeri* May 17, 1919. The plants were immature. Four others were observed in close proximity, all lying with their heads downhill. Frequently a drove of cattle may appear to be grazing in a perfectly normal manner and if they are frightened or driven hurriedly for a few minutes, individuals will fall which previously had shown no apparent uneasiness. After an animal falls from larkspur poisoning, the characteristic symptoms of nausea, weakness, excessive salivation, pronounced sweating, twitching of the muscles of the sides and legs, and convulsive movements are usually observed.

Plate X. Poisoned by Low Larkspur. This Particular Area is Responsible for a Large Loss of Cattle Annually.

It is commonly believed among cattlemen that *D. geyeri* produces bloating only, and if death occurs it is due merely to mechanical effects. In fact, if an animal dies without bloating many owners maintain that some other poisonous plant is responsible. From a chemical point of view, the writer cannot advance any good reason why animals should bloat more upon *D. geyeri* than upon other species of larkspurs. Marsh and Clawson state that, in their experimental feeding, "bloating occurred in some cases, but was not a common symptom. In the cases where it was observed, it seemed to come as one of the later stages of the poison." The authors further state "bloating doubtless adds much discomfort to the animal, and if it lies with the head lower than the rest of the body, may cause death. It is a matter of common knowledge that when animals die of larkspur poisoning upon the range they bloat very quickly, and it seems probable that death may in some cases be immediately caused by the mechanical effects of the bloating". The same investigators noted that the symptoms produced by *D. barbeyi, D. robustum, D. bicolor, D. cucullatum,* and *D. menziesii* were so nearly the same that they could not be distinguished. It is very probable that *D geyeri* is similar to *D. menziesii* in its poisonous nature.

The immediate cause of death in larkspur poisoning is due to respiratory paralysis; the heart action is retarded considerably and stops about as soon as respiration ceases.

PART II.

EXPERIMENTAL METHODS

Determination of Crude Alkaloids.

The quantitative estimation of the total crude alkaloids was made by the volumetric method. In the preparation of the crude alkaloids for the toxicity experiments it was noted that the percentages agreed very well with those obtained by direct titration. (Part I, Figure 3.)

The three species of larkspurs, with the exception of *D. geyeri,* were assayed at three periods of growth,—immature, mature, and seeding stages. The whole plants were aid dried, and reduced to a uniform powder. The moisture content was made upon an aliquot portion so that the final results are based upon a bone dry basis. Twenty five gram samples were percolated with 90 per cent alcohol (cold) until free from alkaloids. The alcoholic percolate was concentrated under reduced pressure to approximately one-third its original volume, and diluted with 1 per cent H_2SO_4 until faintly acidic. The resulting solution was further concentrated by air currents and subsequently washed with petroleum ether. The aqueous alkaloidal solution (colored pale yellow) was then made alkaline with dilute NH_4OH and washed with chloroform until the original mother liquid was free from alkaloid. The chloroformic washings were concentrated to dryness and the residue taken up was 35 ccm. of N/50 H_2SO_4. The excess of acid was neutralized with N/50 KOH. Lacmoid proved to be the most satisfactory indicator. The percentage of alkaloid was calculated as delphinin ($C_{31}H_{49}O_7N$).

Preparation and Properties of Water Extracts.

In the preliminary examination of the larkspurs, the green plants were macerated with water to determine their toxicological value. Incidentally, some interesting observations were noted which proved to be helpful in outlining methods for the subsequent isolation of the alkaloids.

For the toxicity experiments the plant material was disintegrated by means of a meat grinder and digested with an excess (1-6) of lukewarm water for thirty-six hours. The extract was separated by means of a tincture press and administered to rabbits by a stomach tube.

The symptoms were practically identical for each species and correspond to those outlined in Part I. It was found:

(a) That the toxic principles were alkaloidal.

(b) That extracts from the leaves of *D. geyeri* and *D. barbeyi* were more active than those of the stems and flowers.

(c) That no fatalities resulted from the extracts of *D. glaucescens.*

(d) That the extracts from *D. geyeri* and *D. barbeyi* (immature plants) were three to four times more effective than extracts prepared from a similar quantity of mature plants.

(e) That repeated administration of the poison did not produce immunity in the rabbits.

(f) That extracts prepared from plants in the seeding stage did not prove fatal.

Apart from the toxicity data, it was observed:

(a) That the poisonous substances could be extracted (completely) with water.

(b) That the aqueous extracts were acid to litmus (except the very young plants which react slightly alkaline).

(c) That the alkaloids are combined in the plant in the form of water soluble salts.

(d) That water extracts ferment quickly.

(e) That the free larkspur acid occurring in the three species of larkspurs has the same ultimate composition.

Solvents, Extractive Value.

While experimenting with water extracts it was evident that chloroform would remove a considerable quantity of crude alkaloid even though the original extract had not been neutralized with a dilute alkali. Inasmuch as the water solutions were, naturally, stronger acidic and the alkaloidal salts insoluble in chloroform, it was clear that hydrolysis had taken place and that the liberated alkaloids were readily dissolved by this solvent. An experiment was, therefore, outlined with the object of isolating the crude alkaloids from the dried plants by the use of selective solvents and in so far as possible, of reducing the influence of water to a minimum. Approximately two pounds of powdered plants *(D. barbeyi)* were placed in a warm air chamber and dried until only a trace of moisture remained. The material was then introduced into a suitable percolator and extracted with anhydrous chloroform. Aside from coloring and resinous matter, only a trace of alkaloid was recovered. The original plant material was dried in order to expel absorbed chloroform and re-extracted with water. By this treatment it was found possible to isolate a sufficient quantity of alkaloid to justify the conclusion that chloroform was not effective in making the desired separation.

Absolute alcohol was the next solvent employed. The same precautions were taken as in the preceding test. The results were not satisfactory.

Benzene proved to be quite efficient in recovering crude alkaloids, especially those from the aqueous solutions of young plants. An experiment was carried out following the general scheme given above, except that the solvent was not dehydrated previous to its use. Benzene removed a considerable quantity of resinous matter but practically no alkaloids.

It was obvious from these preliminary tests that the alkaloidal salts were insoluble in the solvents used. The negative results, however, were suggestive of a second series of experiments. Ground air-dried plants (containing 6-7 per cent moisture) were mixed with moist magnesium oxide and separated into four samples. Four solvents, chloroform, benzene, ether, and alcohol, were selected which, from preliminary observations, had proved effective in dissolving larkspur alkaloids. By this treatment, it appeared probable that the combination of acid and alkaloid would be broken by the alkaline reaction of the moist magnesium oxide, and that the solvents would readily extract the liberated bases. Upon the completion of the four separate percolations and the subsequent recovery of the crude alkaloids it was found: First, that the chloroform and benzene residues were badly decomposed (the odor of pyridine was noticeable, and upon acidulating the residium with dilute sulphuric acid, a deep red color developed); second, that ethyl ether removed nothing of importance. The alkaloidal material recovered from the percolation with alcohol (96 per cent) was highly colored, although practically all the alkaloids had been extracted from the original plant substance. The substitution of lime and dilute ammonium hydroxide in the place of magnesium oxide was not satisfactory. Further efforts to extract the toxic ingredients by direct selective actions were regarded to be impractical. The method finally adopted for the separation of the poisonous constituents is discussed in the next chapter.

PART III.

CHEMICAL ANALYSIS

DELPHINIUM BARBEYI.

The plant material used in this investigation included the above-ground portions. The roots had been previously assayed (Heyl-Loy-Hepner) for alkaloidal content. Inasmuch as this part of the plant is seldom eaten by cattle, it did not seem advisable to submit it to a detailed examination. Three separate plant collections were made,—immature (June 19), flowering (July 20), and seeding (Sept. 5),—in order to determine any variations in the properties of the various alkaloids.

With the exception of the young plants, a separation was made of the leaves, stems, flowers, and seeds. Then each unit was studied as a whole. The fact that in all recorded experimental feeding there were cases which did not agree with normal experiences led to the belief that a detailed study of the different plant units might be beneficial.

Immature Plants.

As a matter of routine, all parts of the plant were tested for free and combined hydrocyanic acid. The results were negative. While a considerable quantity of enzyme material was separated which reacted slowly with amygdalin, yet no trace of glucosides was noted.

Fifty pounds (air dried) of finely powdered plants were percolated with 75 per cent alcohol to completion. The percolate was concentrated and the residue diluted with water. After standing forty-eight hours, with occasional shaking, the aqueous portion was separated from the solids by filtration. The acid mother liquor was clarified with animal charcoal and potassium sulphocyanide. Upon adding dilute ammonium hydroxide, the alkaloids were extracted with chloroform. The customary separation of the alkaloidal constituents by the use of immiscible solvents was employed. Chloroform was found to be the most satisfactory solvent for the extraction of the larkspur alkaloids. Upon separating the crude alkaloids, it was found that three distinct substances were present—two amorphous and one crystalline.

The principal amorphous alkaloid is precipitated by dilute NH_4OH. It is a complex substance and is insoluble in water. Its melting point is indefinite, decomposition taking place below 170° C. The second amorphous alkaloid is very soluble in water and occurs only in the stems. It is not precipitated by dilute NH_4OH. In an alkaline solution it forms a "jel" which is extremely difficult to separate. It, also, is a complex substance. It is present in the stems in a comparatively small quantity. Both amorphous products are optically inactive. The third alkaloid is crystalline and melts at 124-5° C. It is optically inactive. Like all the larkspur alkaloids which can be crystallized, there is a tendency to form supersaturated solutions. The addition of a crystal being necessary in the majority of cases to induce precipitation. Upon the saponification of amorphous products, it is possible to separate two crystalline derivatives—acid and alkaloid. The former is characteristic of that occurring in the expressed juice of the plants and the latter is identical with the alkaloid isolated and described above. The physical and chemical properties of the alkaloid have been determined.

MATURE PLANTS.

(a) Flowers.

One kilogram of finely ground flowers was completely extracted with 90 per cent alcohol. After removing the excess of alcohol, the residium was further concentrated by warm air currents. The resulting concentrate (125 grams) was placed in two liters of water containing 20 grams of tartaric acid. The aqueous solution was then drawn off and the crude alkaloids recovered by washing the alkaline acqueous liquor with chloroform. Approximately one gram of an amorphous alkaloid was isolated.

While the quantity of material was too small for special study, it was observed that it gave the same reactions as noted in connection with the insoluble amorphous alkaloid isolated from the immature plants. Its toxic value was also similar. Upon hydrolizing with alcoholic potash it yielded the same products as previously mentioned—a crystalline alkaloid and an acid.

(b) Leaves.

Seventy pounds of finely ground leaves were extracted with 75 per cent alcohol until completely exhausted. After removing the excess alcohol by distillation under reduced pressure, the residue was mixed with purified sawdust and extracted with petroleum ether to remove oils, fats, and resins. The original plant material was now dried to expel absorbed petroleum ether and again percolated with 95 per cent alcohol. The concentrate (8 pounds) from the last extraction was diluted with 35 liters of water and placed in closed containers until the insoluble portion settled out. This was separated by filtration and set aside. The aqueous portion, upon standing a few hours, deposited crystals of potassium acid tartrate. Upon extracting with ether, petroleum ether, and ethyl acetate traces of hydrocarbons (paraffine series) were isolated corresponding to hentriacontane, pentatriacontane, and dimyricyl. The crude alkaloids were separated from the original solution by washing repeatedly with chloroform.

The attempt to isolate a crystalline alkaloid from the mature leaves proved fruitless. Apparently an alkaloidal transition takes place shortly after the plants appear and the crystallizable base present in the earlier stages disappears as such with the advance of the season. This interesting deviation was not observed in connection with any of the other species.

The two amorphous alkaloids isolated differ widely. The principal one is precipitated by NH_4OH and is similar in every respect to the product described previously in connection with the immature plants. It is freely precipitated from acid solutions with dilute NH_4OH and in the presence of alcoholic potash readily hydrolizes into a crystalline base and an acid, the properties of which have been briefly described. The second amorphous alkaloid is not precipitated by NH_4OH and is incapable of being resolved into simpler products by saponification. It occurs in small quantities, and appears to be a decomposition product. The free base dissolves readily in benzene, has no definite melting point and is only slightly toxic.

(c) Stems.

Fifty pounds of coarsely ground stems were exhaustively extracted with 75 per cent alcohol and the usual treatment outlined above was followed. It was observed that the subsequent addition of NH_4OH to the alkaloidal salt produced a characteristic colloidal solution. The crude alkaloids were recovered in the form of their salts, and purified by the use of anhydrous solvents. One amorphous alkaloid, amounting to five grams, was separated. It is unquestionably the same water soluble amorphous alkaloid as noted in the stems of the immature plants.

SEEDING PLANTS.

No attempt was made to prepare a large quantity of extracts from plants in the late stage. It was anticipated that no striking differences would be encountered and consequently the chemical study was modified accordingly. As would be expected, the crude alkaloids of the leaves, stems, and pods exhibited considerable deterioration, while those of the seeds were found to be in normal condition.

(a) Seeds.

Aside from determining the quantity of crude alkaloid and the relative toxicity of the seeds, no further study was made. The chemical examination of the seeds from *D. glaucescens* having been previously concluded, there was no reason to believe that the seeds from *D. barbeyi* were essentially different.

(b) Leaves and Stems.

No appreciable difference was found in the composition of the poisons as compared with those isolated from the plants at the flowering stage. The partial decomposition of the alkaloids was evidenced by the quantity of pyridine present.

(c) Pods.

As indicated in the alkaloidal assay of the pods, only a trace of alkaloid is present. No attempt was made, therefore, to isolate a sufficient quantity for identification.

SUMMARY.

Reviewing the results derived from a preliminary examination of *D. barbeyi*, it is clear that three distinct amorphous alkaloids are present throughout the life of the plant. One crystalline alkaloid exists in the free state for a limited period only. The relative difference in the toxicity of the water soluble amorphous alkaloid and the amorphous product precipitated from acidulated solutions by NH_4OH, is negligible. The comparatively small yield of the water soluble portion and the additional fact that the stems are not eaten as readily as the leaves makes it appear probable that its role in poisoning is of minor importance.

Reference has been made (Figure 2) to the apparent increase in toxicity of *D. barbeyi* at the flowering period. The principal poison from the standpoint of activity is the amorphous alkaloid which can be hydrolized by alcoholic potash into simpler derivatives. In the early stages of growth the plant yields a considerable quantity of a crystallizable base. This is much less toxic (Figure 4) than the amorphous product. Considering equal weights of poison for the two periods under consideration, it is apparent that the plants at the flowering stage contain more of the amorphous poison than is found in the undeveloped plants. Naturally the greatly increased quantity of poison in the early season is, in all probability, the vital factor.

DELPHINIUM GLAUCESCENS.

At the time the larkspur investigation was undertaken at this Station it was assumed that all species of larkspurs were quite poisonous. *D. glaucescens* did not appear to be an exception, and, inasmuch as the plant occurred widely distributed, an examination of its poisonous properties appeared desirable. Plant samples were collected at three periods of growth—immature (June 15), mature (July 10), and seeding (August 5)—in order to determine the relative differences in the physical and chemical properties of the poisons. A preliminary examination demonstrated very clearly that in this species the number and form of the alkaloids remains uniform throughout the life of the plant. The different parts of the plant yield the same alkaloids differing only in quantity.

(a) *Leaves and Stems.*

The following table shows the results obtained from a proximate analysis of the mixed leaves and stems:

	I	II	Average
Alcoholic extract (100°)	15.17 %	15.00 %	15.085%
Ligroin (25°-40°) extract (93°)	1.89 %	1.35 %	1.62 %
Starch	2.63 %	0.70 %	1.667%
Pentosans	15.17 %	15.00 %	15.085%
Reducing sugars*	1.77 %	1.66 %	1.715%
Sucrose	0.598%	0.475%	0.536%
Alkaloid total†	0.25 %	0.21 %	0.23 %

Nine kilograms of dried and ground material were extracted with 95 per cent alcohol until the alkaloidal material was completely removed. Upon distilling off excess alcohol there remained 98.8 grams of residue. This was poured into ten liters of water and allowed to stand several days, the clear aqueous portion was next drawn off and washed with petroleum ether. The bulk of the mother liquor was made alkaline and extracted repeatedly with chloroform. The crude alkaloids were purified by precipitating with Mayer's reagent and recovering the free bases with chloroform. An attempt was made to clarify the original mother liquor with basic acetate of lead with unsatisfactory results. The lead apparently formed a water soluble compound because it was impossible to remove the lead as sulphide, especially with the concentration of the aqueous liquor. While no water soluble alkaloids were isolated from this species, in this investigation, there are good reasons to believe that at least one is present. One crystalline and one amorphous alkaloid were separated.

The crystallin base is insoluble in water and melts at 208.5°-209.5° C., chloroform and alcohol dissolves it readily. A weighed portion dissolved in alcohol and observed in a polariscope, exhibits optical activity (dextrorotary). This is the only one of the larkspur alkaloids that is optically active. The crystals belong to the Orthorhombic system and the Bipyramial class. Detailed measurements have been concluded.

The melting point of the amorphous alkaloid is indefinite. It is insoluble in water and is not precipitated by NH_4OH from its acid solutions. Treated with alcoholic potash in alcoholic solu-

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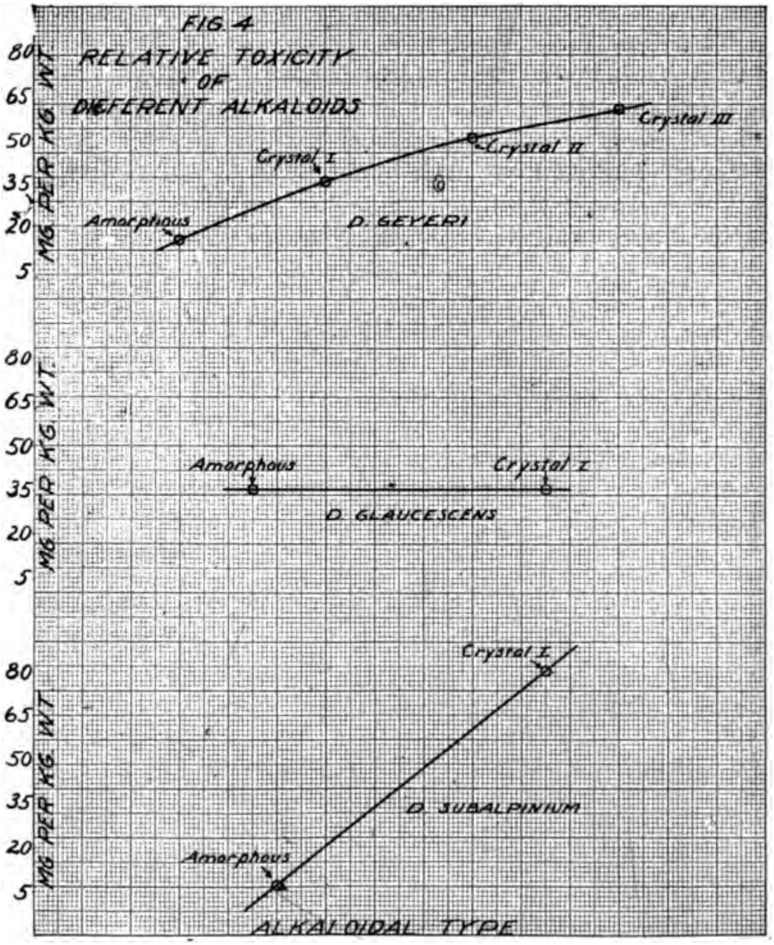
*Calculated as glucose.
†U. S. P. Assay belladonna.

tion, it is decomposed into non-alkaloidal substances. The two alkaloids show no variation in toxicity (Figure 4).



(b) Seeds.

Fifty grams of seeds were separated from the leaves and stems and macerated for several days at room temperature with low boiling petroleum ether. The whole was then transferred to a percolator and completely extracted with petroleum ether. The latter solvent was removed by distillation when 3.0125 grams of a viscid oil remained, or 5.92 per cent of the seeds. Specific gravity of the oil was 0.932, 20° C., volume 3.2 ccm. Linolic acid was identified as one of the ingredients present in the oil. (The yield of liquid fatty acids from *D. barbeyi* seeds was 9.1 per cent.) The residue left from the petroleum ether extraction was percolated with 95 per cent alcohol and the crude alkaloids recovered. The final residue weighed 0.2861 or 0.56 per cent. This agrees very well with the assay made by the volumetric method (Figure 3). *D. glaucescens,* while not troublesome as a poisonous plant, offers an interesting deviation from the closely related species, *D. barbeyi.*

DELPHINIUM GEYERI.

Two separate investigations were made in connection with this species—one of the immature and the other of the flowering plants. Outside of the difference in quantity of crude alkaloid no marked variation was noted for these periods. The results outlined were derived from the chemical study of *D. geyeri* at the flowering stage.

(a) Flowers.

Six hundred and twenty-five grams of dried ground flowers were extracted with three liters of 95 per cent alcohol at about 50° C. for three or four days. The extraction was repeated until the flowers were exhausted. The alcoholic extracts were combined and concentrated. A considerable quantity of mannitol separated, which was set aside. The original residue was further concentrated and, after adding water (1,200 ccm., containing 1 cc. H_2SO_4), the whole was extracted repeatedly with chloroform and then with ether. There still remained an insoluble resin. This was filtered off and dissolved in alcohol. The chloroform resin (dark green) represented 4.13 per cent, the ether resin (dark red) 0.03 per cent, and the alcohol resin (brown) 0.132 per cent of the total material (625 grams).

The dark brown aqueous liquid was rendered distinctly alkaline with ammonia and extracted successively with chloroform, ether, Prollius solution, and petroleum ether, and the resulting solutions extracted with $N_{10}H_2SO_4$, and precipitated with Mayer's reagent. The residual solvents were each distilled. The chloroform left a little resin, the ether a net-work of crystals (mannitol), and the Prollius solution left a minute amount of resin. Petroleum ether removed nothing.

The united precipitates (Mayer's reagent) were suspended in acidulated water and treated with H_2S. This, when again extracted with chloroform, left a residue of 1.8144 grams or 0.291 per cent of alkaloid. The mannitol above was extracted successively with light petroleum ether, ether, ethyl acetate, alcohol, and water. The first three extracts proved to be hydrocarbons of the paraffine series (no action on boiling alc. KOH, fuming H_2SO_4, or fuming HNO_3), with melting points of 61-63°, 61-75°, and 85-110°. These correspond with hentriacontane, pentatriacontane, and dimyricyl. The alcohol removed a considerable quantity of mannitol.

A carbohydrate was separated from the original aqueous mother liquor which gave characteristic reactions of arabinose and galactose and was probably a mixture of them. The residue from the evaporation of the mother liquor gave a red ozazone melting at 195.5-197° C. It contained 28.01 per cent moisture and 42.78 per cent volatile matter.

A proximate analysis of the flowers follows:

	I	II	Average
Alcoholic extract (110°)	31.38%	30.98%	30.18 %
Ligroin extract (92°)	1.98%	2.00%	1.99 %
Starch	2.37%	2.27%	2.32 %
Pentosans	12.80%	12.99%	12.895%
Reducing sugars	7.91%	8.14%	8.025%
Sucrose	5.15%	4.89%	5.02 %
Alkaloid total	0.20%	0.29%	.245%

(b) Leaves and Stems.

Seventy-five pounds of air dried plants were extracted with 75 per cent (cold) alcohol. The alcoholic percolate was strongly acidic due to the excessive larkspur acid present in the mature plants. The usual method of separating the resin and the subsequent recovery of the crude alkaloids by extracting the aqueous mother liquor (alkaline) with chloroform was followed. By a fractional separation of the chloroform extracts, three alkaloids were isolated—one amorphous and two crystalline.

For convenience, the three alkaloids are provisionally designated as Ay_1 (amorphous), Ay_2 (crystalline), and Ay_3 (crystalline). Ay_1 corresponds in its physical and chemical properties to the principal amorphous alkaloid isolated from *D. barbeyi.* Its toxicity is somewhat milder (Figure 4). Upon hydrolysis with alcoholic potash, it is resolved into a crystalline base and acid. The derived crystalline base differs from that obtained from the same treatment of the *D. barbeyi* amorphous alkaloid. It melts at 197-198° C., and is optically inactive. A careful measurement of the crystals has been made. Ay_1 is readily precipitated by NH_4OH from an acid solution. Its melting point is indefinite, decomposition taking place below 160° C. Chloroform, alcohol, and acetone dissolve it. Ay_2 crystallizes in prismatic needles belonging to the monoclinic* system. It melts at 207-208° C. and is optically inactive. Crystallization has to be induced by the addition of an alkaloidal crystal. It crystallizes best from absolute alcohol. Ay_3 is extremely soluble in water and crystallizes in Orthorhombic plates (Pseudotetragonal), melting at 214-215° C.

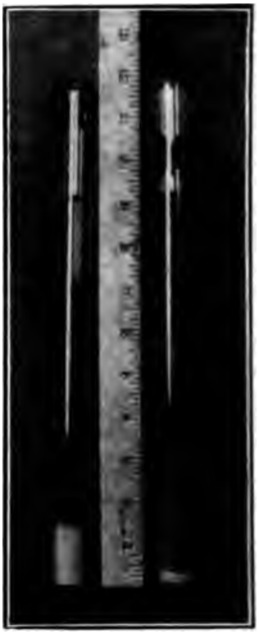


Plate XI. The whitish sediment observed in the cylinders represents the relative quantity of amorphous alkaloid present at two distinct periods. The left hand tube is from immature and the one to the right from flowering plants.

SUMMARY.

The low larkspur, *D. geyeri,* resembles *D. barbeyi* in regard to similarity of amorphous alkaloids. The closely related aconitic acid entering into combination with crystalline bases to produce the principle toxic amorphous alkaloid is a notable resemblance. On the other hand, the crystalline alkaloids of *D. geyeri* are distinctive and in no way show any similarity to the bases of *D. glaucescens* and *D. barbeyi.*

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*(The systems, constants, occurring form, angles, and habits of the crystalline alkaloids isolated from the three species of larkspurs have been accurately measured by Dr. A. J. Moses of Columbia University.)

From a chemical point of view, therefore, the three species vary in many respects. Important plant products, not mentioned in this preliminary bulletin, have been isolated and examined which add further evidence to the statement that there is a specific difference involved in the three species of larkspurs—*D. barbeyi, D. glaucescens,* and *D. geyeri.*

PART IV.

TREATMENT FOR LARKSPUR POISONING

The information concerning the physiological action of the individual larkspur alkaloids is extremely meager. Reference has been made (Figure 4) to the comparative toxicity of each poison, and it is clear that, in the case of *D. geyeri* and *D. barbeyi,* the amorphous product is, in each instance, far the most poisonous. However, the therapeutic value of each is not known. Chemically, the amorphous compounds, corresponding with delphinine more or less, are quite stable substances. A number of saponifying reagents were used in the place of alcoholic potash for effecting hydrolysis; magnesium methylate, K_2CO_3 (alcoholic solution), CaO, and MgO were not found to be sufficiently energetic. Oxidizing reagents, such as hydrogen, peroxide, nitric acid, and potassium permanganate, apparently have a more destructive effect than the chemicals usually employed in plant analysis.

The conclusion is evident that remedial measures given by gastric administration would only be partially effective because: (1) the poison is quite resistant to those substances ordinarily given, and (2) the amount of alkaloid is such that antidotal reagents would not come in contact with the bulk of it. The most advisable recourse is that outlined by the Bureau of Animal Industry, U. S. D. A. Bulletin 365, where suitable chemicals are injected directly into the blood by means of a hypodermic syringe.

The remedy has the following formula:

Physotigmin salicylate	1 grain
Pilocarpin hydrochlorid	2 grains
Strychnin sulphate	½ grain

This formula would apply to an animal weighing 500 to 600 pounds. For a large steer or cow of 1,000 pounds or more, the dose should be twice that given in the formula. These materials can be obtained from any dealer in drugs. The physostigmin salicylate and pilocarpin hydrochlorid are furnished in veterinary hypodermic tablets, each containing one-half grain of physostigmin salicylate and 1 grain of pilocarpin hydrochlorid. The strychnin sulphate can be obtained in tablets each containing one-half grain. These dissolve easily, and it is well to have two or three doses ready in small homeopathic bottles. For yearlings one should use two of the physostigmin-pilocarpin tablets and one of the half-grain strychnin sulphate tablets dissolved in enough water to fill an 8-dram homeopathic bottle; for full-grown cattle four of the physostigmin-pilocarpin tablets and two of the strychnin tablets dissolved in an 8-dram bottle full of water should be used.

It is best to use an all-metal hypodermic syringe. This can be easily cleaned by boiling. The form which has been found most useful for the field is that known as the Quitman syringe. In this the needles are carried in the hollow piston, and a case is therefore unnecessary. The syringe should be of the 10-centimeter size, which holds half an 8-dram bottle of water, so that the remedy can be given to yearlings in a single dose while for mature cattle the syringe must be filled twice. The needle is most conveniently inserted in the shoulder. There is little doubt that prompt treatment of animals poisoned by larkspur will result in the saving of most of the cases.

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Poisonous Plants of Wyoming

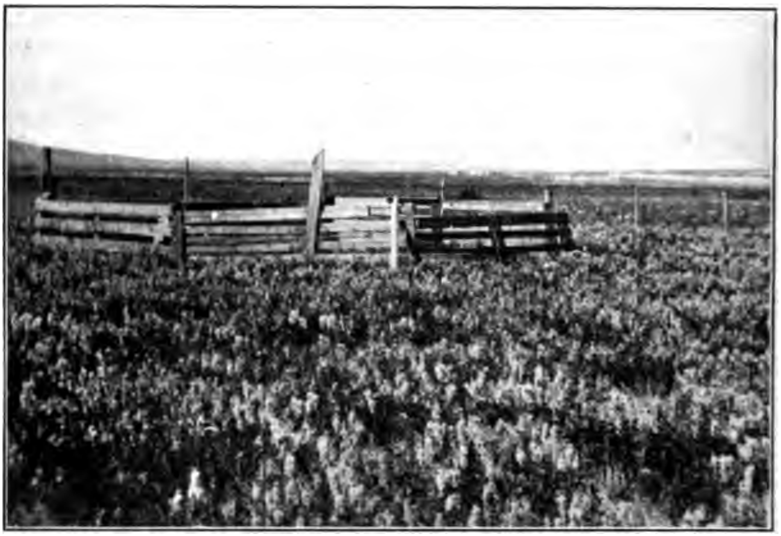
O. A. BEATH

Poisonous plants, while confined to certain areas of Wyoming, are nevertheless responsible for losses of considerable magnitude among stockmen. Available statistics are lacking, but, from an estimate based upon losses in several localities, it seems probable that the average must be as great as three per cent. As would be anticipated, there is a considerable variation from year to year not only in aggregate losses, but in the classes of stock affected. Many deaths, due to unascertained causes, are difficult to diagnose, inasmuch as certain diseases produce symptoms closely related to those of plant poisoning.

As the area of the stock ranges becomes more and more restricted, the successful raising of live stock is certain to become more difficult, especially in districts where poisonous plants occur. In the past, the first suggestion of trouble has been the finding of dead carcasses and then "poison weed" was given as the cause, although no particular weed was, perhaps, suggested. During the last few years, there has been a very creditable advance made by stockmen in attempting to get acquainted with the troublesome weeds. While the number is comparatively large, yet those known to be persistently dangerous are far less numerous than ordinarily supposed. Through inability to recognize those that are detrimental, many owners suffer losses year after year, thinking that some other cause is responsible. The need, therefore, of a simple illustrated bulletin, giving the general location, period of activity, symptoms, etc., of the principal poisonous plants has been felt for some time. It is hoped that the information found herein will be a means of developing a keener interest in the general understanding of the poisonous plants of Wyoming. From whatever angle the problem is viewed, one is confronted with several difficulties. The varied distribution of the plants, the character of the poisons involved, and the methods of treatment under range conditions, are in themselves problems which require at all times the best efforts of specialists on the one hand, cooperating with the stockowners on the other, to reduce losses to a minimum.

Contributory Causes.

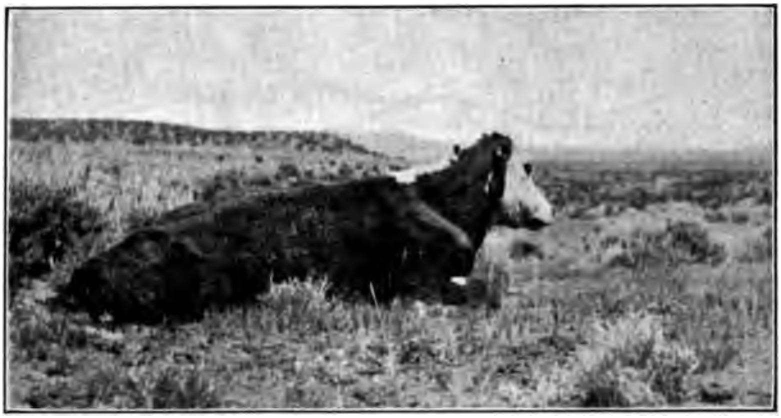
Contributing factors incidental to plant poisoning are indeed numerous. Ordinarily, plants are protected from animals through various sources, such as unpleasant odor, acrid or bitter taste, toxic character, and in some cases such protective devices as spines. The depraved appetite for unusual and unappetizing plants is a factor of importance. In the early spring, animals are often tempted to eat those plants which appear palatable and succulent regardless of their toxic or poisonous nature. There are several poisonous plants which usually appear before the range grasses begin to freshen. Among the more conspicuous ones may be mentioned species of larkspur and death camas. In this connection, a condition frequently prevails which is difficult to avoid, and this is the late snowfall, which leaves the more advanced plants exposed. Naturally, the desire to obtain something green is in-



An experimental feeding corral. Important information may, sometimes, be obtained by forcing animals to feed more or less exclusively upon a suspected poisonous plant, such as the two-grooved milk vetch shown above.

stinctively followed, and many times these outstanding, attractive plants prove to be the animals' only choice. In a state of nature, animals, as a rule, avoid plants of a toxic nature, whereas imported stock, and particularly those better bred, are more often poisoned because they do not easily acquire the habit of "rustling". Sheep are especially variable in their choice of plants, not only individually in the flock, but from day to day.

The susceptibility of different species of livestock is a factor of considerable importance. One species, e. g., the pig, may readily throw off plant material (poisonous), while another, e. g., the horse, may be unable to do so, and hence be more seriously affected. Aside from the individuality and susceptibility of an animal, one finds that its physical state and the condition of the range greatly affect the actual losses from injurious plants. During the spring and early summer of 1920, cattlemen of the state lost an unusually large number of cattle from larkspur poisoning. Two reasons may be advanced for this loss: first, the cattle were, generally speaking, poor and consequently low in resistance; second, the larkspur appeared early and afforded about the only kind of available food. The aggregate loss resulting, therefrom, was surprisingly large.



A case of larkspur poisoning. Note that the ears have been cut off to induce bleeding—a worthless practice. The scarcity of suitable forage, in this area, is particularly significant.

The importance of the fatigue factor when taken into consideration with plant poisoning is too little emphasized, in our literature. The writer has observed cases of poisoning on the range from plants which, when fed in a corral, proved to be entirely harmless. The circumstances usually noted in the above cases were: scant vegetation, animals fatigued and hungry from long drives, and a new range environment.

The one-night camp for sheep is desirable in dangerous areas. The shortage of feed that naturally results in the immediate vicinity of a more or less permanent camping ground of necessity tempts sheep to eat injurious plants that ordinarily would not be touched. The bedding out system appears to be practical and has many advantageous features other than eliminating hunger by unnecessary trailing.

A clump of tall larkspur before flowering. A conspicuous poisonous plant, such as this one, often proves to be a temptation to browsing animals.

A precaution not always heeded is that of an adequate salt supply. Range observations supplemented with actual tests have definitely proved that animals, and particularly sheep, are likely to acquire a depraved appetite for toxic plants if not given sufficient salt.

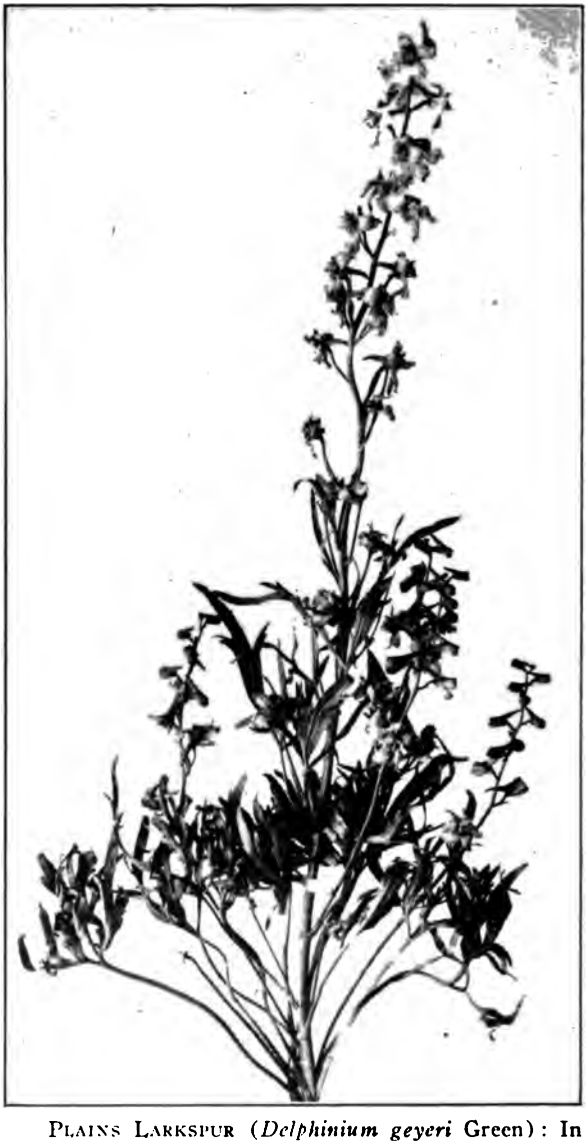
Important Poisonous Plants.

The principal poisonous plants of more or less general distribution may be classified into two groups: First, those that occur rather generally distributed and in large quantities over the state; second, those found locally and in more or less restricted areas. In the former, would be included certain species of loco, the larkspurs, certain species of death camas, water hemlock, the lupines, and arrow grass. In the latter group, one would probably include certain vetches, woody aster, aconite, *Psoralea tenuiflora,* milkweed, and *Corydalis aurea.* Probably in discussing poisonous plants, mention should be made of the fact that forage plants are sometimes infested with fungi, such as rusts and moulds. These may be the cause of the poisoning when found on forage which is ordinarily entirely harmless.

Certain stock losses occur from time to time which are indirectly caused by non-poisonous forms of vegetation. Fatalities in these instances are produced through mechanical injuries and disturbances such as abrasions, compaction, bloating, etc. Sores caused by foxtail may, in addition to being painful, be the source through which infectious bacteria enter the blood stream. The woody tissues of the common greasewood are, under certain conditions, quite difficult to digest. If a considerable quantity is eaten at one time, it may gradually accumulate into a compact mass and subsequently ferment. Bloating quite frequently follows this condition.

Preventive Measures.

The question is frequently asked how may losses be prevented if animals are to be grazed where poisonous plants occur. Unfortunately, prevention cannot be obtained by vaccination, as is the case with several of the infectious diseases. Perhaps a partial answer would be to acquire accurate information relative to range stock and range conditions. Even then, some stock-owners would be forced to meet the problem with considerable uncertainty. The fact that a certain class of stock may have grazed upon the same range for a number of years and escaped trouble gives no assurance that poisoning may not occur. On the other hand, it should be borne in mind that animals, as a rule, do not instinctively select toxic plants as a forage, that all classes of livestock are not necessarily susceptible to the same poisonous plants, that not all poisonous plants are dangerous from their initial appearance on to maturity and that only in one or two instances do animals acquire a depraved appetite for harmful plants. Poisonous plants in most cases, grow in abundance only in limited areas, and, consequently, if one is familiar with the virulent stage of their growth and the kind of stock they affect, losses may be greatly reduced through the application of controlled methods of grazing.



PLAINS LARKSPUR (*Delphinium geyeri* Green): In this species the stems rise from among a tuft of root-leaves and soon develop open clusters of blue flowers, as seen in the illustration. The parts of the seed capsule have spreading tips. This is the larkspur known as "poison weed" and this name should not be applied to other larkspurs or to any other plants.

PLAINS LARKSPUR.

This species of larkspur is the most common of the Wyoming larkspurs. It is responsible for more losses among cattle than are all the other poisonous plants of the state combined. Under favorable conditions of growth, dense patches may be found which add much to the picturesqueness of the landscape. The average height of this larkspur is about 15 inches.

Where it grows. Found quite generally distributed over the state at altitudes varying from 4,000 to 8,000 feet. It thrives best on a rather coarse, well drained type of soil. This plant grows only in open areas on the plains and foothills.

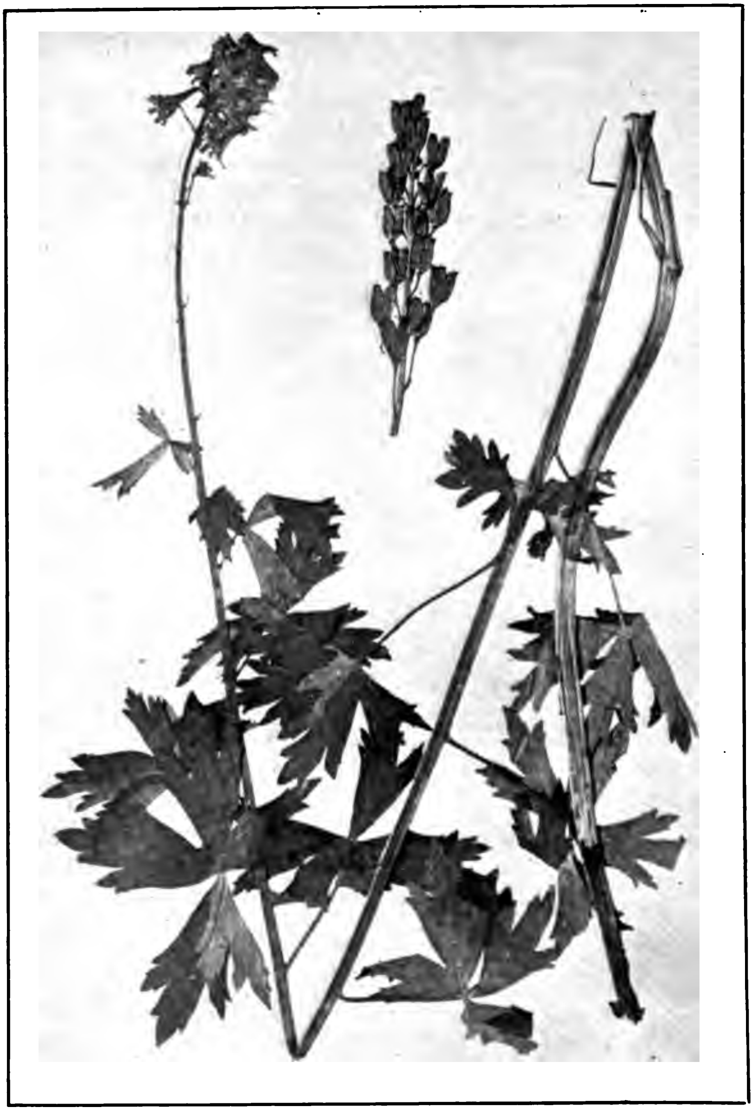
When it appears. It appears, as a rule, early in May, and generally is in full bloom by the middle of June. After the flowering stage, unless the season is especially moist, the plants dry up rapidly and disappear from the range.

Animals affected. Larkspur poisoning is confined almost exclusively to cattle, while sheep appear to be immune. Horses and mules seldom eat large enough quantities to produce poisoning.

Poisonous period. Dangerous throughout its growth. Poisoning is due to a definite active principle, occurring mostly in the leaves. As a general rule, more losses occur during the early stage of the plant's development. Occasionally cattle prefer the flowering larkspur tops, even if good forage is available.

Symptoms. Symptoms vary more or less, depending largely upon the severity of the poisoning. Those most characteristic are: inability to walk without staggering or falling, nausea, salivation, pronounced sweating, bloating (quite common in the later stages), muscular twitchings of the sides and legs, and frequently convulsive movements. The immediate cause of death is due to respiratory paralysis.

Treatment. Where prevention cannot be strictly carried out, the treatment recommended by the Bureau of Animal Industry undoubtedly is the most effective. (See low larkspur.)



TALL LARKSPUR (*Delphinium barbeyi* Huth.): Attention is called to the stoutish stems, the coarser and fewer leaves and the dense cylindrical cluster of deep-blue flowers.

TALL LARKSPUR.

This species of tall larkspur is the most common of the larkspurs found growing at the higher altitudes. It is a very poisonous plant, but fortunately its restricted growth in forest reserves, coupled with the fact that in many instances sheep only are grazed where the plants occur, very materially lessens stock losses. As in the case of the plains larkspur, there are areas where the tall larkspur forms dense patches. The height of this plant varies from 2 to 5 feet.

Where it grows. Occurs in all the National Forests of the State at altitudes ranging from 8,000 to 11,000 feet. It thrives best in open draws and mountain parks.

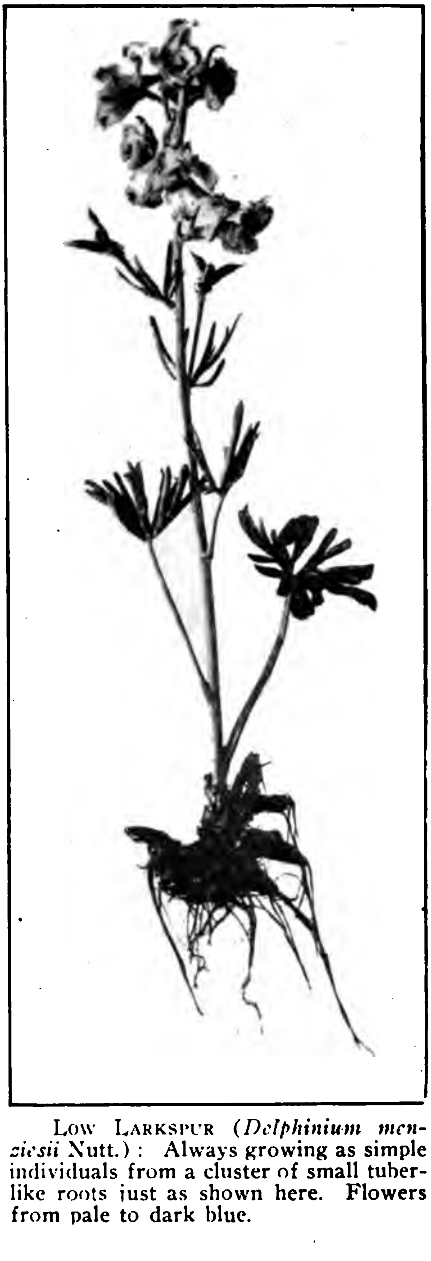
When it appears. Usually appears by the middle of June. The time of blooming varies naturally with the season and altitude.

Animals affected. Same as other species of larkspurs.

Poisonous period. Dangerous from its appearance until the flowers disappear. The seeds are poisonous, but very few losses result from this source. The mature stems, leaves and pods contain but little poisonous matter.

Symptoms. See plains larkspur.

Treatment. See low larkspur.



Low Larkspur (*Delphinium menziesii* Nutt.): Always growing as simple individuals from a cluster of small tuber-like roots just as shown here. Flowers from pale to dark blue.

LOW LARKSPUR.

Considering *Delphinium nelsonii* and *Delphinium menziesii* to be identical species, then it is clear that, insofar as distribution is concerned, this type of larkspur should be mentioned. However, not much significance need be attached to it otherwise. The plants are comparatively small and do not, as a rule, grow in dense patches in this state. The roots of this larkspur consist of a cluster of tubers, as shown in the picture, and in this respect resembles the native aconites.

Where it grows. It is found at altitudes of from 4,000 to 10,000 feet on open hillsides and mountain parks. The plants seldom grow over one foot in height. The only area, that has come to the writer's attention, which is more or less covered with low larkspur, is found in the Medicine Bow National Forest.

When it appears. This is the first larkspur to appear in the spring. On account of its wide variation in altitude, the time of blossoming is greatly modified. In the foothills, the flowering plants may usually be found by June first; at higher altitudes (9,000 to 10,000 feet), the flowers may not appear until nearly a month later.

Animals affected. Cattle, mainly.

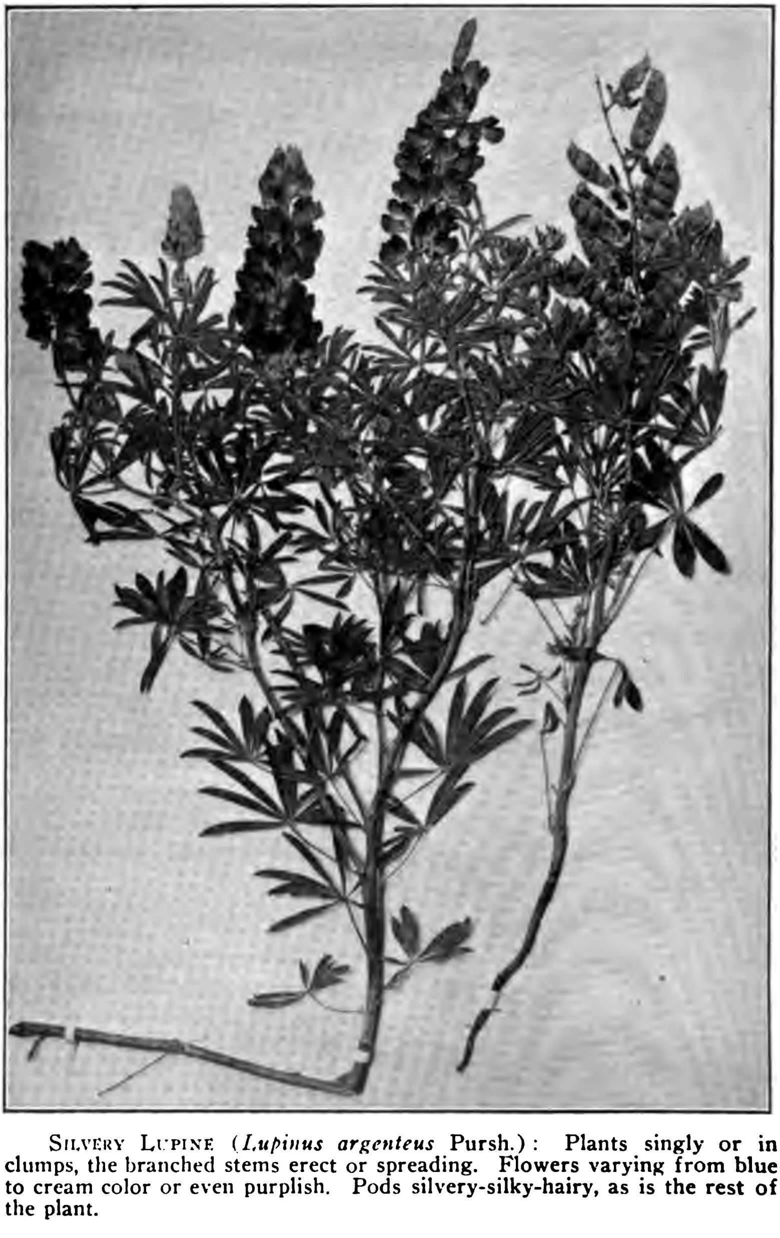
Poisonous period. Poisonous during the whole life of the plant.

Symptoms. Same as other species.

Treatment. Any treatment that is to be effective should be applied as promptly as possible. Animals poisoned by larkspur should be kept quiet, with head higher than rest of body. Bloating should be relieved by sticking. The use of a trocar is advisable for this purpose. The general practice of bleeding is often detrimental in larkspur poisoning. The hypodermic administration of the following substances is recommended by the U. S. D. A.:

Physostigmin salicylate	1	grain
Philocarpine hydrochloride	2	grains
Strychnine sulfate	½	grain

This quantity dissolved in approximately 1 tablespoon of water would be the proper dose for an animal weighing 500 to 600 pounds. An animal weighing about double this weight would receive twice the quantity given in the formula. The syringe commonly used in blackleg vaccination will answer the purpose in most cases. The injection is usually made in the shoulder. The ingredients in this formula may usually be obtained from drug dealers.



SILVERY LUPINE (*Lupinus argenteus* Pursh.): Plants singly or in clumps, the branched stems erect or spreading. Flowers varying from blue to cream color or even purplish. Pods silvery-silky-hairy, as is the rest of the plant.

SILVERY LUPINE.

There are several different kinds of lupines in the state, but fortunately not all of them are poisonous, at least, not to the same extent. The silvery lupine is not only the most common but also the most poisonous. Therefore, a brief description of this plant will serve in a general way as an illustration of the other lupines.

Where it grows. It thrives best along streams and irrigation ditches where the soil is moistened to some extent by seepage water. This lupine rarely grows at an altitude above 8,000 feet. It requires a soil quite free from alkali and containing more humus than is required by many of the other poisonous plants.

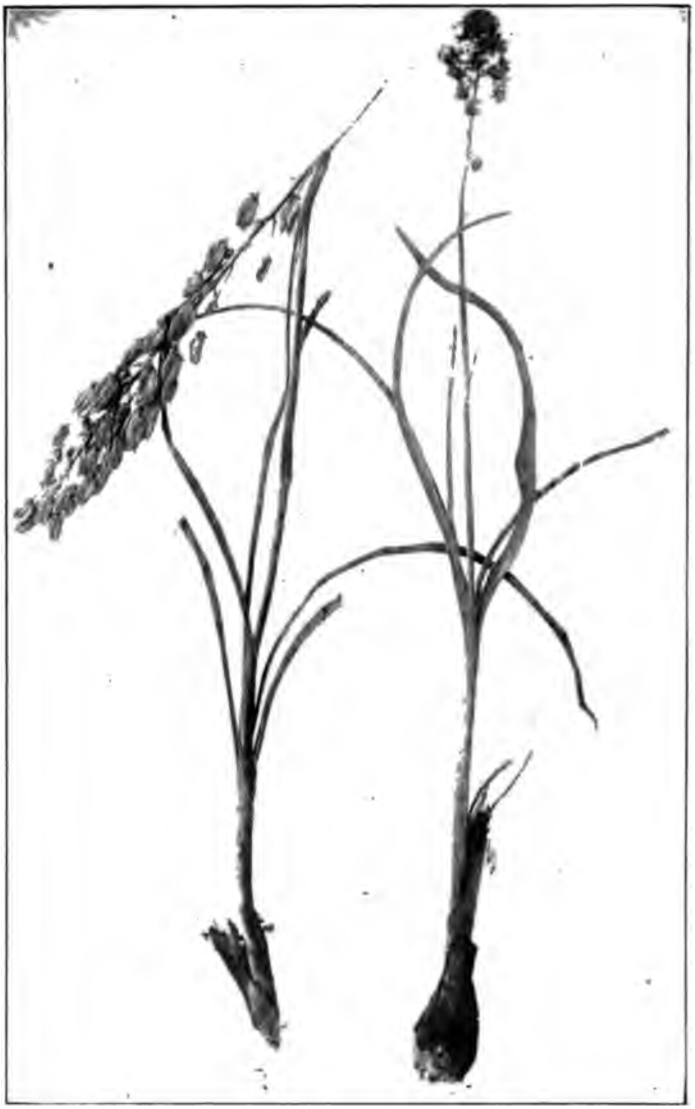
When it appears. Under normal conditions, the silvery lupine appears early in June and is in partial bloom by the first of July. The fruit appears shortly afterwards, and from then on one may find flowers, green and mature pods, all on the same plant.

Animals affected. Affects sheep mainly. Other animals, horses, cattle, swine, and goats, may be poisoned if enough of the plant is eaten.

Poisonous period. Considered dangerous from the time the green pods appear until the plants dry up in the fall. Distinct toxic substances occur in the leaves and flowers, but apparently in too small a quantity to be effective. The seeds and pods retain their poisonous properties when dried, and occasionally losses result from the feeding of hay contaminated with lupine.

Symptoms. Animals may die shortly after the first symptoms appear or may live several days. A day may elapse between the eating of lupine and the appearance of symptoms, so that animals may trail a long distance from the seat of trouble before suspicion is aroused. With reference to symptoms exhibited by sheep, there may be frothing at the mouth, more or less trembling, nausea, and bloating. Symptoms especially characteristic are: excitement, leading to running about and butting into other animals and objects; convulsions, accompanying attacks of labored breathing.

Treatment. No satisfactory remedy is known that can be used advantageously for range animals. Most lupine poisoning may be avoided by keeping hungry animals away from lupine patches until their appetites are, at least, partially satisfied.



DEATH CAMAS* (*Zygadenus intermedius* Rydb.): The illustration is distinctive, showing the characteristic bulbs, leaves, flowers, and seed capsules. The flowers are white but with a distinctly greenish cast.

***Note: Many other common names are in use but all are misleading. Since the plant is neither onion nor corn, to refer to the disease as "onion-poisoning" or "corn-poisoning" leads to confusion and should be avoided.**

DEATH CAMAS.

The two principal species of death camas of Wyoming are *Zygadenus intermedius* and *Zygadenus elegans*. The *intermedius* is very widely distributed over the state. Most of the losses due to Zygadenus poisoning may be traced to this one species. While *Z. elegans* resembles the *intermedius* in general characteristics, yet its growth at the higher elevations in the mountains gives it a restricted zone, and consequently very little poisoning results. The summary that follows, therefore, pertains to *Z. intermedius*.

Where it grows. It appears to thrive on the sandy plains as well as in the drier and stonier foothills. Its most favorable location is in sandy swales where the soil remains moist for a comparatively long time. The plant is seldom found above an elevation of 8,000 feet.

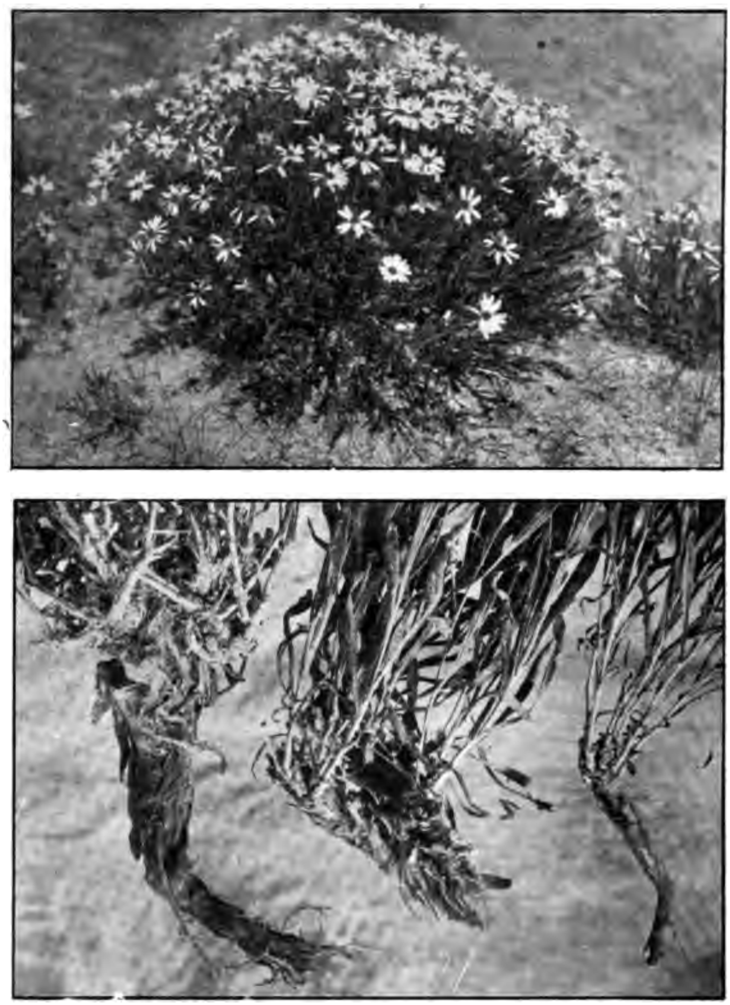
When it appears. The grass-like leaves appear early in the spring, usually by the middle of May. These leaves are soon followed by the flower stalk which becomes six to ten inches high, terminating in a spike-like cluster of yellowish-green flowers. The flowering stage is generally reached by July first. As the season advances, the flower stalk lengthens out slightly into a nearly naked seed stalk bearing rather large capsules.

Animals affected. Sheep are more frequently poisoned than cattle and horses. This is probably not because sheep are more susceptible, but rather is due to the way in which sheep are managed upon the range. A band of sheep is usually herded, consequently the forage is apt to be grazed closely, and when passing over a death camas patch, a sufficient quantity of the plant may be eaten, by many of them, to produce poisoning.

Poisonous period. Dangerous throughout the life of the plant.

Symptoms. The characteristic symptoms of death camas poisoning as observed upon the range are: frothing at the mouth; nausea accompanied by vomiting; exhaustion accompanied sometimes with nervousness, the relaxation from which may cause an animal to lie for days in a stupor. It is not uncommon for a large number of sheep in one band to become affected.

Treatment. No effective remedial measures can be recommended. Like most other poisonous plants, trouble need not be feared if suitable feed is available.



WOODY ASTER (*Xylorrhiza parryi* Gray): The upper picture illustrates a clump of aster in bloom. The large daisy-like white flower heads are borne upon branches emanating from one root. The basal portion of the plant is shown in the lower photograph.

WOODY ASTER.

In years past, this plant has been the cause of greater sheep losses in Wyoming than any other single poisonous agency. At the present time, losses are being greatly reduced by careful practices in the handling of sheep. The plant never occupies an entire range, but is usually confined to small districts (from a few acres to several hundred), and it is therefore possible to avoid the more conspicuously infested areas.

Where it grows. Its growth is confined to an impervious, sticky clay more or less intermixed with gravel and containing appreciable quantities of alkali and other salts. Many of the slopes and ridges adjoining the Medicine Bow and North Platte Rivers afford ideal conditions for its growth.

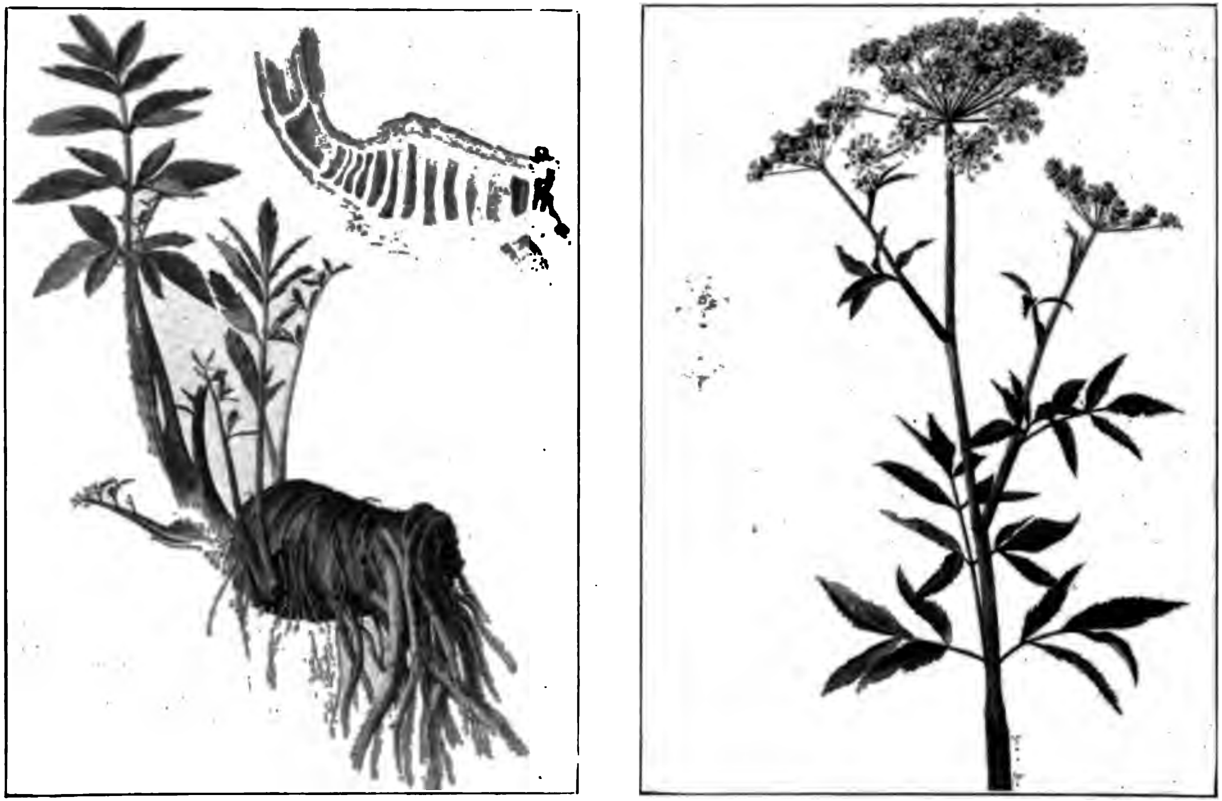
When it appears. Usually the plant leaves out before May first. The flowers appear about the middle of June. Beginning about the first part of July, the plants become yellowish-brown in color and lose their attractive appearance.

Animals affected. So far as is known, sheep are the only animals poisoned by woody aster.

Poisonous period. Most of the losses occur during the earlier stages of the plant's growth. The plant, however, at no time fully loses its toxic activity and, therefore, is to be guarded against throughout its existence.

Symptoms. There appears to be a distinct variation in the nature of the poison corresponding to the plant's development. Poisoning from the immature and early flowering plants is characterized by: abdominal pain; bloating; serious disorganization of the internal organs, but no perceptible change in the color of the blood. The active principle in the older plants kills more quickly; alters the composition of the blood; but does not produce organic disturbances of sufficient magnitude to be readily observed in post mortem examinations.

Treatment. Due to a lack of experimental evidence, no specific treatment can be recommended. Laboratory tests indicate that a mild alkali should be effective, but its practical usefulness remains to be proven.



WATER HEMLOCK (*Cicuta vagans* Greene): This shows the typical rootstocks and the characteristic leaves, white flowers and small fruits. Suspected plants should be compared with the figures. (Reproduced by the courtesy of the U. S. Department of Agriculture.)

WATER HEMLOCK.

There are several plants, which belong to the parsnip family, occurring in the same places as the water hemlock (Cicuta). The non-botanist may, therefore, be confused in his identification unless considerable care is taken. The giant angellica might easily be taken for water hemlock, so far as appearance, odor and location are concerned. Fortunately, the poisonous properties of the Cicuta are confined to the underground portions (rootstocks) and therefore the aggregate losses are never alarmingly high.

Where it grows. Quite generally distributed over the state, principally along irrigation ditches and streams and in swampy meadows.

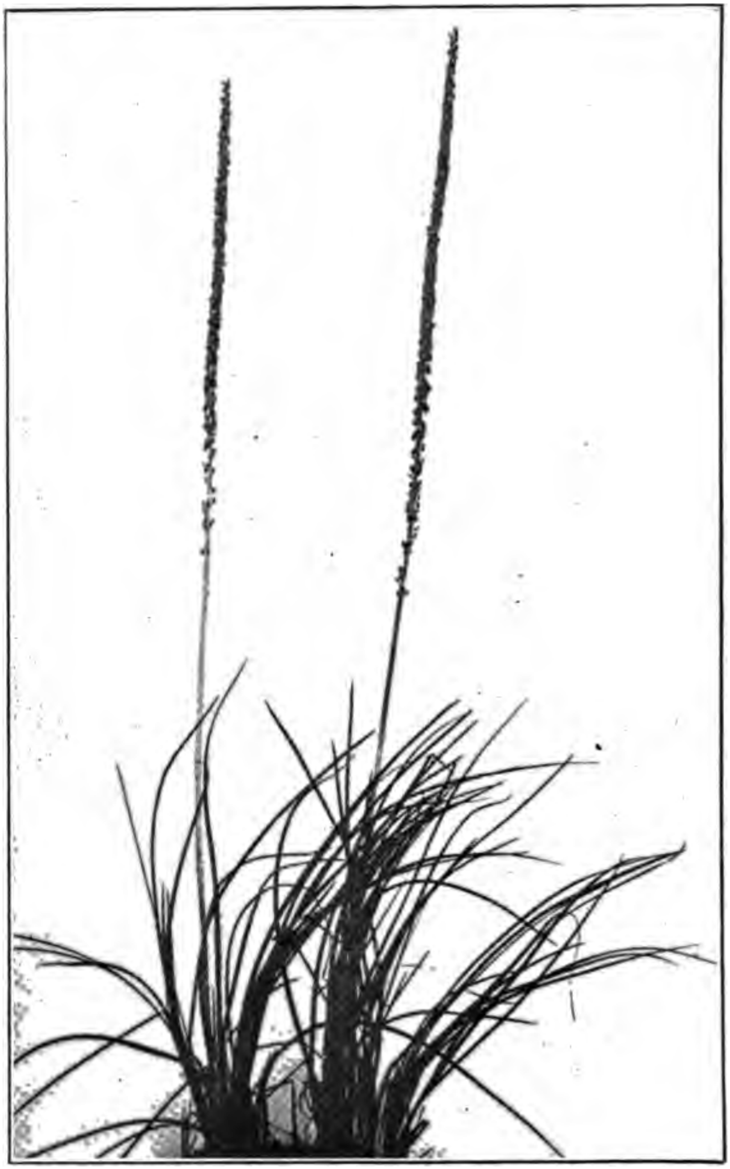
When it appears. Since the above ground portion (green or dry) appears to be harmless to stock, one is concerned mainly with the poisonous root stalk. Naturally, the seasonal variation of the foliage is of no particular interest here.

Animals affected. Poisonous to all classes of stock.

Poisonous period. Root stalk considered dangerous at any season of the year.

Symptoms. Acute abdominal pain; mental excitement, and finally violent convulsions.

Treatment. The poison is so active that usually time does not permit the administration of antidotes.



Arrow Grass (*Triglochin maritima* L.): Readily distinguished from grasses by the long jointless stem and the fleshy sheating rush-like basal leaves. Flowers in terminal spikes, inconspicuous and greenish. (Reproduced by the courtesy of the Nevada Experiment Station.)

ARROW-GRASS.

Recent experiments carried out by the Nevada Agriculture Experiment Station show that under certain conditions, arrow-grass may poison both sheep and cattle. Inasmuch as this plant occurs in practically all the alkaline bogs and marshes of Wyoming, a description of the plant is given so that its identity may be established and the necessary precautions followed.

Where it grows. Widely distributed over the state in wet, alkaline soils, and along the edges of bogs and sloughs. In some meadows the flowering stalks of arrow-grass may be entirely absent and the stool-like clusters of leaves be mistaken for wire grass. The flowers and seed-pods are sometimes confused with those of water plantain.

When it appears. Arrow-grass is one of the first plants to appear in the spring. The flowers usually appear about the first of July and the seeds about a month later. The plants remain green until late in the fall.

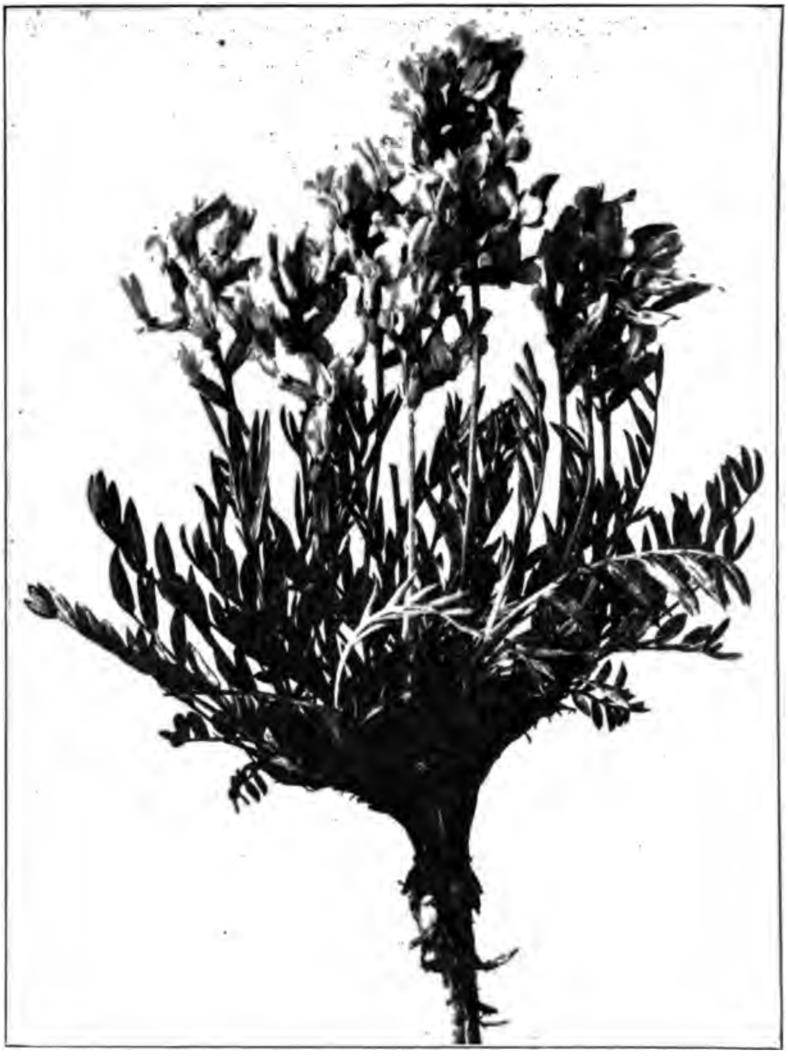
Animals affected. Poisonous to sheep and cattle.

Poisonous period. Poisonous in both the green and dried conditions.

Symptoms. Appear to be those of cyanide poisoning.

Treatment. The activity of the poison is such that the possibility of successful administration of an antidote seems to be rather remote.

The growth of arrow-grass being confined to bogs and to the low portions of meadows, excludes it quite generally from summer grazing. When hay is cut containing this plant, care should be taken to either eliminate it entirely or to feed it sparingly with other suitable forage.



White Loco (*Aragallus albiflorus* A. Nels.): This loco has a large semi-woody root from the crown of which spring the numerous leaves and white flower stalks. The purple loco (*Aragallus lamberti* (Pursh.) Greene) is taller, slenderer and less tufted. (Reproduced by the courtesy of the U. S. Department of Agriculture.)

WHITE LOCO.

This is the plant commonly known in Wyoming as the "loco". It is widely distributed over the state, at elevations ranging from 4,000 to 10,000 feet. The loco plants in general have long semi-fleshy roots which enable them to withstand severe drougths. The extent to which animals in Wyoming, particularly horses, are injured by white loco is quite a difficult question to answer. Naturally, there is, from year to year, more or less loco poisoning; but, on the whole, it is not comparable with losses encountered in some of the neighboring states.

Another species of loco, *Aragallus lamberti*, is also common in Wyoming. It has a purplish blossom and in many respects closely resembles the white loco *(Aragallus albiflorus)*. The poisonous properties of the two species are undoubtedly very similar.

Where it grows. It grows largely on knolls and ridges and often in great field-like patches on the plains. It thrives in sandy soils.

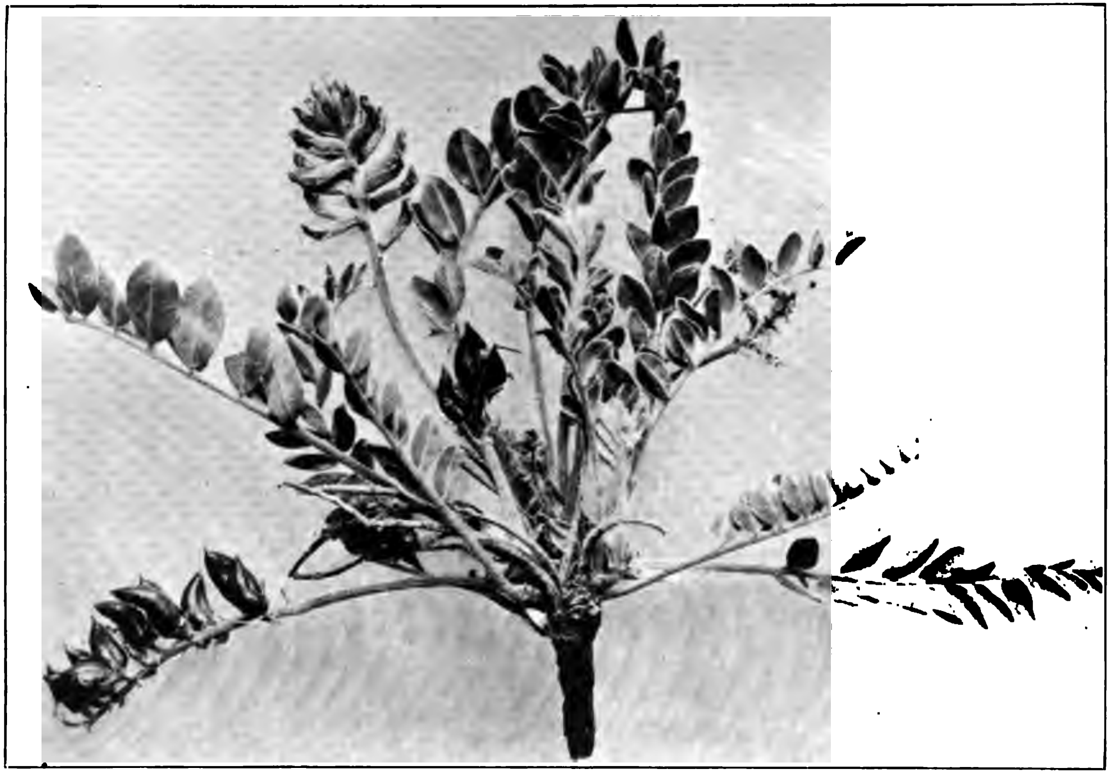
When it appears. The white loco, in common with some other species, remains green throughout the winter. The flowers usually appear by the first of June, although the season and elevation greatly modify the growth of the plant.

Animals affected. While horses, cattle and sheep are susceptible to the disease, the principal losses in Wyoming occur among horses.

Poisonous period. The loco appears to be a dangerous plant at any season of the year. The active principle, whatever it may be, is quite equally distributed throughout the whole plant.

Symptoms. In contrast to the action of most poisonous plants, the effects of loco progress slowly. Usually several weeks or months elapse before the disease is observed to be present. The important symptoms are: loss of flesh; irregularity of gait; weakness; and lack of muscular coordination. Symptoms exhibited by different classes of stock naturally vary within certain limits. For details relating to the loco disease, Farmers' Bulletin No. 1054 should be consulted.

Treatment. No antidote has been found which is uniformly successful. If practical, locoed animals should be removed from infested areas and given nutritious food.



WOOLLY LOCO (*Astragalus mollissimus* Torr.): Stems short but branching and bearing erect leaves and elongated stalks of purple flowers. (The above cut is not characteristic and in spite of the fact that it has appeared with this name in the bulletins of several states, may well represent some other species.—A. N.). (Reproduced by the courtesy of the U. S. Department of Agriculture.)

WOOLLY OR PURPLE LOCO.

This species of loco comes into the extreme south-eastern section of Wyoming from the three states, Kansas, Colorado, and Nebraska, in all of which it is more or less common. On account of its limited distribution in this state, the woolly loco is not to be regarded as an important poisonous plant. However, a description of the plant is given largely because this species is known to be poisonous, and to be responsible for heavy stock losses in other states.

In comparing the pictures of the two locos (white and purple), one should be able to pick out the outstanding differences.

Where it grows. Grows more or less scattered on the plains, usually more conspicuous in the depressions than on the ridges. The soil requirements are not especially significant, since it may be found where there is a considerable variation in the quality of the soil.

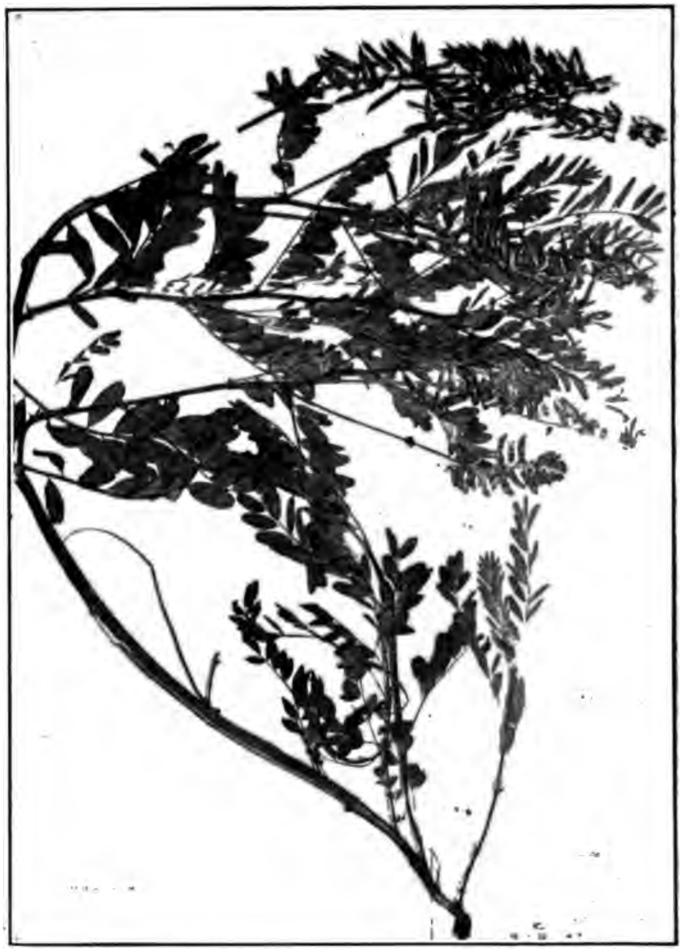
When it appears. Usually appears during the last of April and blooms about the first of June.

Animals affected. Feeding experiments show that while all classes of stock are susceptible, the losses from this source are limited almost exclusively to horses.

Poisonous period. There appears to be no marked seasonal variation.

Symptoms. See white loco.

Treatment. See white loco.



TWO-GROOVED MILK VETCH (*Astragalus bisulcatus* (Hook.) Gray): This legume forms large clumps and is readily distinguished by the violet flowers and by the pods which, on the lower side, have a marked ridge with a sharp groove on either side of the ridge.

TWO-GROOVED MILK VETCH.

Ordinarily, this plant is not to be considered particularly dangerous. On account of its coarse appearance and offensive odor, most animals instinctively avoid it. A description of the plant is given because we know that, under certain conditions, it may produce poisoning. Corral feeding, using sheep and cattle, has not aided us materially in explaining certain cases of range poisoning. Therefore, as long as suspicion is held concerning this vetch, it is advisable to know something of its nature.

Where it grows. Quite generally scattered over the state. Grows in dense clumps and attains a height of from 2 to 3 feet. It grows mostly on the moist sides of ravines and gentle slopes.

When it appears. Usually appears during the month of May and goes to seed the latter part of July.

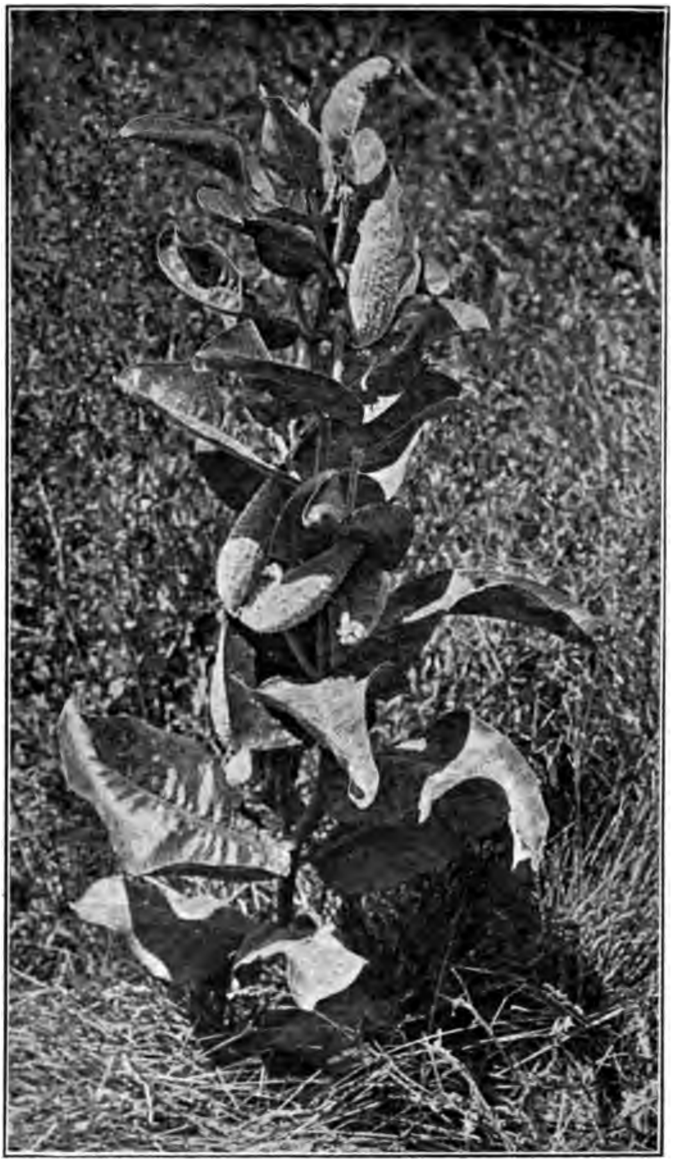
Animals affected. Poisonous to sheep and cattle, but we have no evidence as to its effect upon horses.

Poisonous period. Probably poisonous throughout its whole life. Poison is found in all parts of the plant.

Symptoms. When eaten by sheep and cattle in moderate quantities for a long period, symptoms develop which correspond in every way to those of loco poisoning.

Suspicion is held as to the effect produced when fatigued animals are permitted to eat excessive amounts of vetch at one feeding. A few cases of range poisoning point to the fact that it may produce death under these conditions in a comparatively short time.

Treatment. No definite suggestions.



MILKWEED (*Asclepias speciosa* Torr.): This is the most beautiful and conspicuous milkweed in the state. Its large broad leaves and handsome purplish flowers are characteristic. (Reproduced by the courtesy of the Nevada Experiment Station.)

MILKWEED.

The broad-leaved or showy milk-weed is another one of the lesser poisonous plants of Wyoming. When the natural forage of a range becomes depleted, it occasionally happens that animals are forced to eat this plant, although it is disliked by them.

Recently the Nevada Experiment Station has conducted some milkweed feeding experiments with sheep. The parts of the plant used were: green leaves, leaves as they dried up naturally in the field, seeds, and the pods.

Where it grows. Fairly widely distributed over the state. Usually found on a soil somewhat richer than the average type of range soil.

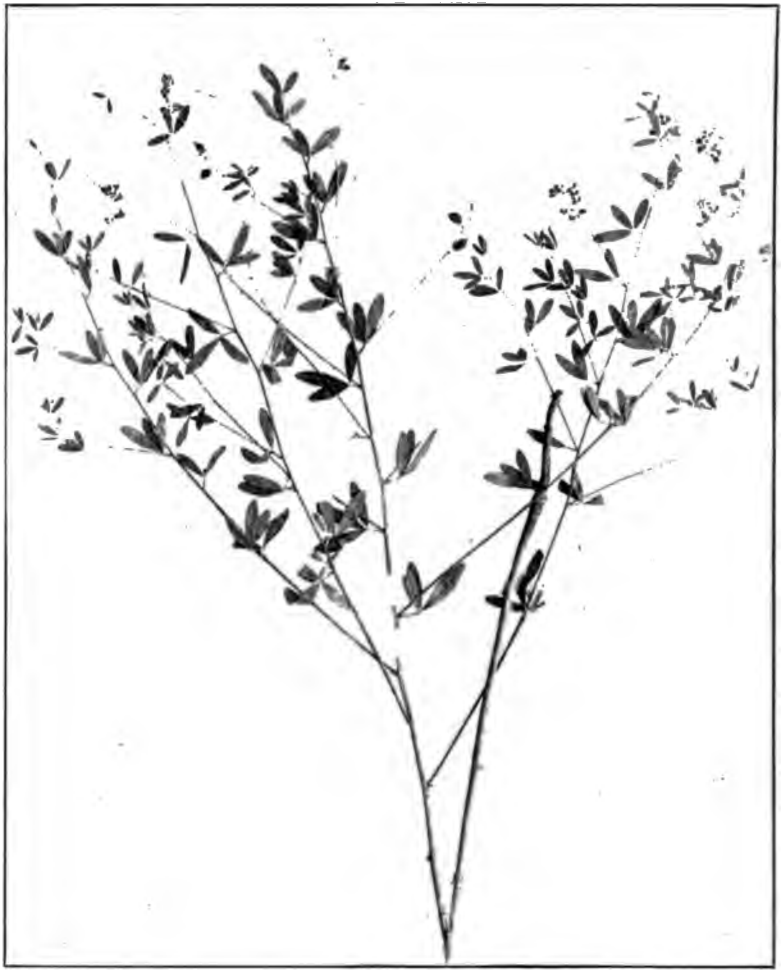
When it appears. Usually appears in June and remains green until late summer.

Animals affected. Poisonous to sheep. Its effect upon cattle and horses is not definitely known.

Poisonous period. The Nevada investigators found in their experimental feeding work that (1) the green leaves are poisonous, (2) relatively large amounts are required to cause poisonous symptoms in a mature range ewe, (3) the pods alone are poisonous, (4) the seeds are highly poisonous, and (5) the plant dried naturally in the field contains but little of its original poisonous matter.

Symptoms. The symptoms observed in the above mentioned feeding tests and probably characteristic of this form of poisoning were: extreme dullness; total loss of appetite; and a tendency to lie down. In severe cases, the breathing was distinctly irregular, the breath being expelled forcibly.

Treatment. No suggestions other than prevention.



SLENDER PSORALEA (*Psoralea tenuiflora* Pursh.): A bushy plant with hard wiry slender branches, and small purplish-blue pea-blossoms. Pods very small and glandular-warty. (Reproduced by the courtesy of the U. S. Department of Agriculture.)

SLENDER PSORALEA.

The fact should be borne in mind that there are a number of poisonous plants in Wyoming which are perhaps just as deadly as the larkspurs, species of camas, etc., but are ordinarily regarded as unimportant for the reason that animals do not eat them, at least, only rarely. Definite information concerning the effects of many of these plants upon domestic animals is either meager or lacking entirely. *Psoralea tenuiflora* is a poisonous plant, beyond any question of doubt, but on account of its bitterness, is seldom molested. (Psoralea is pronounced sor-a-le′-a.)

Where it grows. On the plains of the eastern part of the state.

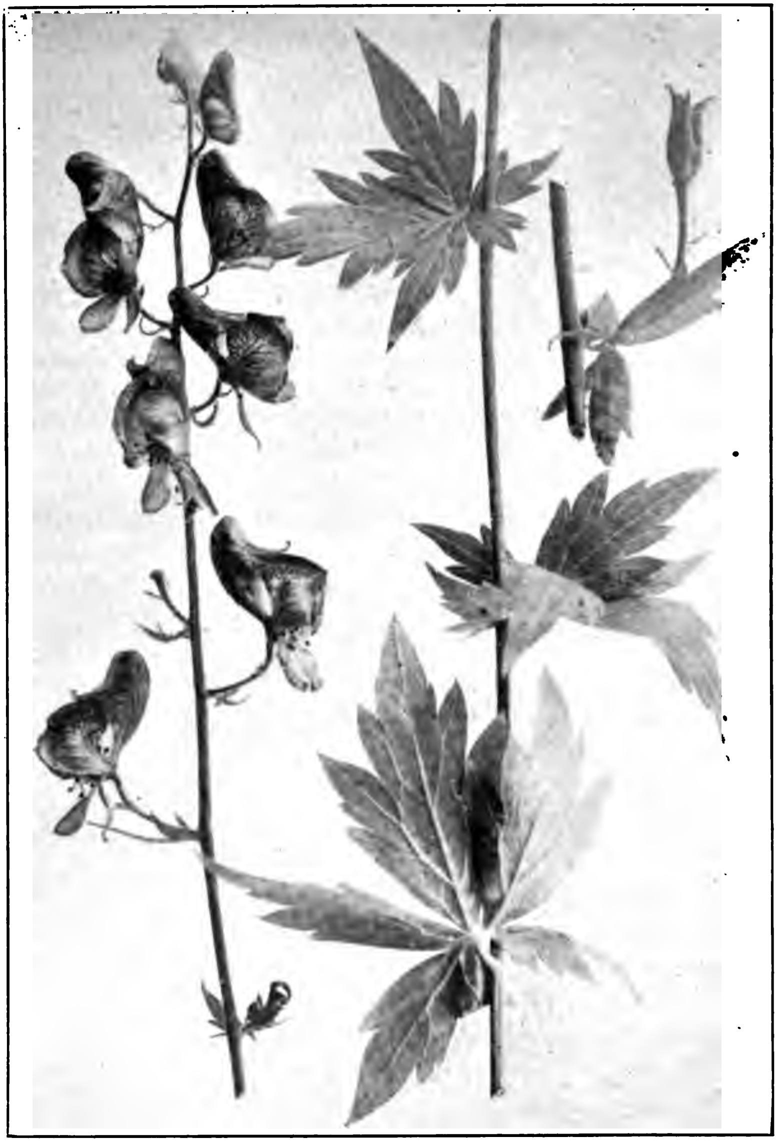
When it appears. Usually appears in May and dries up in September.

Animals affected. Said to be poisonous to cattle and horses.

Poisonous period. Not definitely known.

Symptoms. Experimental evidence lacking.

Treatment. Inasmuch as the plant is rarely eaten, it follows that unless the pasturage is poor or the plant is fed in large quantities, very little trouble may be expected from this source.



ACONITE (*Aconitum columbianum* Nutt.): The careless observer might readily pass this for a larkspur, but attention to the blue blossom shows instead of the "*spur*" a rounded "*hood*"; hence the common name "*monkshood*" is sometimes used. (Reproduced by the courtesy of the U. S. Department of Agriculture.)

ACONITE.

While the aconites are poisonous plants, it is pretty definitely settled that they do not poison range stock. Mention is made of the aconite *(A. columbianum)* because it not only grows in close proximity to the tall larkspur, but may be confused with it.

Where it grows. This species of aconite grows at elevations ranging from 5,000 to 10,000 feet, along brooks and springs and in low ground. Outside of Yellowstone Park, the aconite occurs only in scattered districts.

When it appears. The aconite and tall larkspur have about the same seasonal growth.

Animals affected. It has been demonstrated that cattle are not susceptible. Sheep and horses may be fatally poisoned by aconite.

Poisonous period. Poison is said to be largely in the seeds and roots so that there is greater danger to grazing animals during the seeding stage.

Symptoms. Closely resemble those produced by the larkspur.

Treatment. No specific antidote is known.

BULLETIN NO. 130 **JANUARY, 1922**

UNIVERSITY OF WYOMING

AGRICULTURAL EXPERIMENT STATION

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AGE 61 DAYS, WEIGHT 65 POUNDS

NATIVE FEEDS FOR FATTENING LAMBS

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Native Feeds for Fattening Lambs

F. A. HAYS

INTRODUCTION

The importance of the sheep industry in Wyoming calls for additional data on the value of native feeds for fattening lambs. While the work that has been done by no means solves the problem, it is thought advisable to publish a report of results to date. Other publications will be available as the work progresses.

The Wyoming Station (Bul. 109) fed three groups of 25 lambs each for 112 days to compare oat and pea silage, when fed with corn and alfalfa hay and when fed with alfalfa hay only, with a basal ration of corn and alfalfa for fattening lambs. The table below summarizes the results:

	Lot I lbs.	Lot II lbs.	Lot III lbs.
Avg. initial weight	46	46.1	45.7
Avg. final weight	73.8	76.2	64.6
Gain per lamb	27.8	30.1	18.9
Avg. daily gain	.25	.27	.17
Avg. daily feed per lamb:			
Grain	.47	.47	——
Alfalfa	1.8	2.3	2.3
Silage	.7	——	.74
Feed per 100 lbs. gain:			
Grain	191	176	——
Alfalfa	730	854	1376
Silage	284	——	439
Cost of 100 lbs. gain	$7.33	$7.32	$9.13

The Montana Station (Bul. 131) fed two groups of 15 pregnant ewes for 77 and 74 days respectively to find the value of sunflower silage added to a basal ration of alfalfa hay and oats. The summary is presented in a table as follows:

	Lot I lbs.	Lot II lbs.
Average initial weight	167	164
Average final weight	180	176
Average gain per ewe	13.2	12.4
Average daily feed per ewe:		
Alfalfa hay	3.89	2.99
Sunflower silage	——	2.18
Oats	.20	.17

The silage-fed group gained a little less than the check group up to lambing. In this trial about 2.5 pounds silage replaced one pound of alfalfa hay.

A trial was carried on in 1918-19 by the Wyoming Station (unpublished data) in which a group of 12 ewe lambs were fed oat and pea silage in addition to a basal ration of grain and native hay for 85 days. At the end of this period the 11 surviving lambs were changed to the same feed of sunflower silage as they had received of oat and pea silage. The same grain allowance was continued and what native hay they would consume, was fed. The table presented below shows a larger daily gain for the group after being put on the sunflower silage. It seems possible that sunflower silage was slightly superior in this trial.

	Oat & Pea Silage lbs.	Sunflower Silage lbs.
Initial weight	1183	1220
Final weight	1325*	1294
Total gain	142	74
Avg. daily gain	.14	.16
Avg. daily feed per lamb:		
Hay	1.25	1.5
Silage	1.5	1.5
Grain	.75	.75

*Including weight of lamb removed.

OAT AND PEA SILAGE VS. SUNFLOWER SILAGE AND COTTONSEED MEAL VS. LINSEED MEAL FOR FATTENING LAMBS

METHOD OF PROCEDURE

Animals Used

November 17, 1919, 102 choice feeder lambs, mostly Shropshire-Merino crosses, were purchased through a commission firm in Denver. These lambs came from southern Colorado and averaged 63.14 pounds each when purchased. The cost delivered at the Experiment Station was $14.06 per cwt. Although these lambs had been inspected and dipped at shipping, they developed lip and leg disease soon after arrival. They were immediately isolated and given medical treatment until recovery was complete with no loss of lambs up to about the last of January, 1920, when the experiment began.

The feed during this period of quarantine consisted of native hay, oat and pea silage, cracked corn, and cottonseed meal. The lambs were never off feed, were vigorous and active and made good gains during the 66 days.

Allotment and Rations Fed

The two poorest lambs of the lot were discarded on January 26, 1920, and the remaining one hundred were divided into four groups of 25 each with special attention to breeding, type, thrift, color markings, size, and sex. Each lot contained 14 wethers and 11 ewes.

Group I was fed cottonseed meal at the rate of one-half pound daily per lamb, native hay one pound, and oat and pea silage a full feed. Group II received cottonseed meal at the rate of one-half pound daily per lamb, native hay, one pound, and the same allowance of sunflower silage as Group I received of oat and pea silage. Group III was allowed cottonseed meal at the rate of half a pound daily per lamb and native hay a full feed. Group IV was fed old process linseed meal at the rate of one-half pound daily per head and the same amount of native hay as was given Group III.

All lambs received hay in a rack at 8:00 a. m. each day. The concentrate was fed on silage in a trough to Groups I and II and in troughs to Groups III and IV at 5:00 p. m. each day. The amount of concentrates was the same in all four groups, namely: one-half pound per head. The silage feed of Group II was regulated by the amount of oat and pea silage eaten by Group I. The native hay allowance was regulated by Group III.

Water from the city supply was constantly supplied in tubs. Salt was furnished in the form of small crystal stock salt in a box in each pen.

Feeds Used

Cottonseed Meal. This product was manufactured by the Texas Cake and Linter Co., Dallas, Texas. It was a high grade meal with a guaranteed analysis of protein 43% min., fat 6% min., and fiber 12% max.

Linseed Meal. Old process linseed meal produced by Midland Products Co., Minneapolis, Minn., was used. It was a standard grade product with a guaranteed analysis of protein 32%, fat 5%, and fiber, 9.5%.

Native Hay. The hay came from the Coen ranch, northwest of Laramie. There was a high percentage of wheat grasses and very little marsh or broad-leaf grass. It was light and clean and contained no injurious plants. The hay was baled from the stack as used in the experiment.

Oat and Pea Silage. This was a good grade of silage. There was a fair proportion of peas to oats. The crop was ensiled when the Canadian field peas were hardening in the pods and the oat grains were rather well matured. Some water was used in filling the silo.

Sunflower Silage. Mammoth Russian sunflowers were ensiled when 2 per cent of the plants had reached the blossom stage. The growth was not very coarse and all plants were harvested before frost. The product kept well, but was rather high in water, due to the immaturity of the plants. The silage was much relished.

Housing and Range

Each group of lambs had access to a pen 16 by 20 feet in the east part of the sheep barn. These pens communicated with an outside lot 16 by 30 feet, made of woven wire. In stormy or cold weather, the doors of the barn were closed and the lambs protected from wet snows.

Weights

Group weighings were made on three successive days at the beginning and at each two-week period one weighing was made. The final weight is also the average of three weighings. Below are the results in tabular form.

EXPERIMENTAL RESULTS

All feeds used in this trial were analyzed from composite samples collected as the feeding progressed. The Station Chemist reports as follows on the feeds used:

	Dry Matter	Ash	Crude Prot.	Crude Fiber	N. Free Ext.	Fat
Cottonseed meal	92.15%	5.96%	42.02%	12.12%	23.41%	8.64%
Oil meal	90.48	6.67	33.83	9.06	32.74	8.18
Native hay	94.53	8.33	7.73	29.64	46.81	2.02
Oat and pea silage	30.44	2.53	3.08	9.08	14.43	1.32
Sunflower silage	20.53	2.52	2.31	5.76	9.23	.71

TABLE I.

Oat and Pea Silage vs. Sunflower Silage and Cottonseed vs. Linseed Meal for Fattening Lambs.

January 27 to April 6, 1920—70 days.

25 Lambs per Group	Group I Cottons'd Meal, Nat. Hay, Oat & Pea Silage lbs.	Group II Cottons'd Meal, Nat. Hay, Sunflower Sil. lbs.	Group III Cottons'd Meal, Native Hay lbs.	Group IV Linseed Meal, Native Hay lbs.
Average initial weight	71.65	71.61	71.87	73.00
Average final weight	88.81	85.51	87.59	87.07
Total gain per lamb	17.16	13.90	15.72	14.07
Average daily gain	.25	.20	.23	.20
Average daily feed:				
Cottonseed or linseed meal	.46	.46	.46	.46
Native hay	.96	.98	1.79	1.79
Oat and pea or sunflower silage	2.35	2.35		
Feed consumed per 100 lbs- gain:				
Cottonseed or linseed meal	186.48	230.32	203.56	227.49
Native hay	390.21	493.47	798.85	888.33
Oat and pea or sunflower silage	956.64	1181.84		
Total	1533.33	1905.63	1002.41	1115.82
*Feed cost of 100 lbs. gain	$16.46	$20.50	$19.02	$22.11

*FEED PRICES: Native hay, $28.00; Cottonseed meal, $77.00; Linseed meal, $85.00; Oat and pea silage, $8.00; Sunflower silage, $8.00.

Table I shows that the lambs in Group I were heavier than those in any of the other groups at the close of the experiment. They had not, however, attained a weight sufficient to be penalized on the market. Group III, getting cottonseed meal and native hay, stood second in final weight, Group IV, on linseed meal and native hay, stood third, and Group II, the sunflower silage group, showed the lowest average final weight. In the average total gain per lamb for the 70-day period Group I stood first with a gain of 17.16 pounds, Group III second with a gain of 15.72 pounds, Group IV third with 14.07 pounds, and Group II last with 13.90 pounds. It is interesting to note that the lambs in Group II, getting cottonseed meal, a half feed of native hay, and a full feed of sunflower silage, made practically the same daily gains as those in Group IV, on old process linseed meal and native hay.

The daily consumption of meal was the same in all four groups, namely, .46 pound per head. The average hay consumption of the group getting oat and pea silage is slightly less than the average hay consumption of the group getting sunflower silage. This difference may be due to the fibrous and bulky nature of the oat and pea silage satisfying the demand for bulk to a greater extent than sunflower silage or to the fact that the sunflower silage carried a smaller percentage of dry matter.

Feed consumption per hundred pounds gain varies considerably with the groups. Group I required only 186.48 pounds of cottonseed meal for each hundred pounds increase in weight. This stands out in contrast to 230.32 pounds of cottonseed meal required by Group II; 227.49 pounds by Group IV, and 203.56 pounds by Group III. There is thus a very appreciable saving of protein concentrate in the oat and pea silage fed group. Possibly the protein content of oat and pea silage acted as a sparer of cottonseed meal while the sunflower silage seems to have have had the reverse effect in this particular experiment. An average digestion coefficient of 53.84 per cent has been reported for the protein of sunflower silage compared with a coefficient of 75 per cent for the protein of oat and pea silage. These facts indicate that from the standpoint of protein at least, oat and pea silage surpasses sunflower silage.

The native hay requirement for one hundred pounds increase in body weight differs rather widely in the two silage-fed groups. The lambs getting sunflower silage required approximately 123 pounds more native hay to each hundred pounds gain or about 26 per cent more. In the groups getting native hay as the sole roughage, namely Groups III and IV, the hay requirement varied less widely. The difference in hay required is in favor of Group III, getting cottonseed meal and amounts to only about 11 per cent.

The difference in the amount of oat and pea and sunflower silage required for each hundred pounds gain appears to be quite significant. The lambs getting oat and pea silage required 225 pounds less silage than those getting sunflower silage—a saving of about 24 per cent. Chemical analyses already presented of the two kinds of silage show that oat and pea silage contains 48 per cent more dry matter than sunflower silage. Based on dry matter content, there would be very little difference in the value of sunflower and oat and pea silage.

It is important that we consider at this time the relative replacement values of the feeds used as based on gain-producing ability. Comparing Group I with Group III, 956.64 pounds of oat and pea silage replaced 408.64 pounds of native hay and saved 17.08 pounds of cottonseed meal to each hundred pounds of gain produced. Disregarding the small saving on cottonseed meal, 2.3 pounds of oat and pea silage replaced one pound of native hay or 4600 pounds of oat and pea silage proved equal to one ton of native hay. If the native hay was worth $28 per ton, the oat and pea silage was worth $12.17 per ton. Making a similar comparison between Groups II and III, it will be found that 1181.84 pounds of sunflower silage replaced 305.38 pounds of native hay, but in Group II there was a somewhat greater consumption of cottonseed meal. Disregarding the slightly greater consumption of cottonseed meal in the sunflower silage-fed group, 3.8 pounds of sunflower silage replaced one pound of native hay or 7600 pounds of sunflower silage was about equal to one ton of native hay. If the native hay was worth $28 per ton, the sunflower silage was worth approximately $7.37 per ton. Regarding cottonseed meal and old process linseed meal, we find that nearly 12 per cent more linseed meal than cottonseed meal was required to make a hundred pounds gain, and that about 11 per cent more hay was required in the linseed meal-fed group. This seems to indicate that cottonseed meal is about 10 per cent more valuable than old process linseed meal when both are fed with Wyoming native hay. With all feeds as high as they were during the winter of 1919-20, the cost of 100 pounds gain was high in each of the groups. Feed costs are commonly considered to approximate 90% of the total costs in lamb feeding.

These lambs, though they showed only a moderate degree of finish, were shipped to Denver April 16, after having been kept on dry feed for ten days after the close of the experiment. They had not been fed sufficient concentrate to bring them to a degree of finish sufficient to bring out a difference in the sale value of the different lots. They sold for $17.12 net on the Denver market at the close of the experiment and shrank 3.57 per cent in shipment.

OAT AND PEA SILAGE AND SUNFLOWER SILAGE FOR FATTENING LAMBS

In previous tests at this Station, oat and pea silage and sunflower silage were compared using native hay as part of the roughage. In the test now to be reported, alfalfa hay was used and cracked corn furnished the grain part of the ration. It seemed advisable to learn also if silage could be advantageously used to replace more than half of the roughage

The objects of the experiment were: to compare oat and pea silage and sunflower silage fed in the same proportion as a source of succulence, to study the effects of different amounts of silage when fed in conjunction with alfalfa hay, and to secure data on the value of a basal ration of alfalfa hay and cracked corn for fattening lambs.

METHODS OF PROCEDURE

Animals Used

High grade Rambouillet wether lambs with a small percentage of Cotswold blood were purchased from a local sheepman on Oct. 29, 1920. There were 102 of these lambs selected from a total of 300. They were very uniform in size, breeding, type and thrift at the time of purchase. The average weight per lamb delivered at the University Farm on October 29th was 65.24 pounds. The lambs had been pastured on the range with their dams until the date of purchase and were in very thrifty condition. The initial cost was $11.75 per hundred. Upon arrival in the University yards, the lambs were fed for 21 days on alfalfa hay, sunflower silage and cracked corn in order to accustom them to the new conditions and to feeds to be used.

Allotments and Rations

Two of the poorest lambs were discarded and the remaining hundred, all wethers, were divided into four groups of 25 each with due regard to uniformity in weight, breeding, type, and thrift. They were then started on a 21-day preliminary experimental period with the rations as follows: Group I, alfalfa hay, full feed and one-half pound of cracked corn per head; Group II, alfalfa hay one-fourth feed, sunflower silage full feed, and one-half pound cracked corn per head; Group III, alfalfa hay one-half feed, sunflower silage full feed, and one-half pound of cracked corn per head; and Group IV, the same ration as group III. The hay allowance was fed at about 9:00 A. M. each day. The grain was fed at 4:30 P. M. and as soon as it was cleaned up the silage was fed. Check group I regulated the hay and grain given the other groups. Group II regulated the silage given to groups III and IV. Great care was taken to avoid a waste in any of the feeds and records were made of any feed weighed back.

Water was given the lambs from the city supply and was always available. Salt in the form of small crystal stock salt was kept in each pen.

Feeds Used

Alfalfa Hay. During the preliminary feeding period and for 18 days after the opening of the experiment proper, baled second cutting alfalfa from the R. K. Kondoh ranch was used. The hay was of fair quality but showed considerable "foxtail," somewhat reducing its value and causing trouble among the lambs by the beards affecting the eyes. During the last 52 days of the experiment, loose second cutting alfalfa from the Gibbs ranch was fed. It was of excellent grade and free from "foxtail."

Cracked Corn. This product was purchased from a local dealer and came from Nebraska. It was ground to a medium degree of fineness and was from a high grade of corn.

Sunflower Silage. Mammonth Russian sunflowers were used. The crop was cut when about 14% of the plants had reached the blossom stage. The stand was rather uneven and there was a considerable percentage of heavy stalks. During the preliminary period, first-class unfrosted silage was available but, with the beginning of the experiment proper, silage from frosted plants was fed. Freezings had been so severe that the plants were entirely killed and water was added during filling. The silage was dark in color and somewhat woody in appearance and did not possess the aromatic properties of silage made from fresh, green plants. Its keeping qualities were not materially affected.

Oat and Pea Silage. During the preliminary period, oat and pea silage was not fed due to the fact that it was not available. The silage consisted of Colorado Field Peas and Swedish Select Oats, seeded at the rate of about 60 pounds each per acre. The oats were drilled in after the peas had been planted 10 days. There was a good proportion of peas to oats and an excellent grade of silage was secured. Some water was added during ensiling.

CHEMICAL ANALYSES

Composite samples of the feeds used were collected as the experiment progressed and chemical determinations were made on these at the close of the experiment by the Station Chemist, who reports the following results:

	Dry Matter	Ash	Crude Prot.	Crude Fiber	N. Free Ext.	Fat
Alfalfa hay—Kondoh	94.64%	7.65%	15.15%	28.25%	41.54%	2.05%
Alfalfa hay—Gibbs	94.51	8.22	15.60	27.11	42.16	1.42
Cracked corn	87.89	1.39	8.84	1.87	71.85	3.94
*Sunflower silage	22.86	2.77	1.97	6.34	11.37	.41
Oat and pea silage	32.13	2.80	3.19	9.39	15.58	1.17

*No analysis was made of the unfrosted sunflower silage.

WEIGHTS

Group weighings were made at the end of each two week interval and on three successive days at the close of the experiment.

PRELIMINARY EXPERIMENTAL RESULTS

While records were kept of the 21-day preliminary experimental period, the time was too short to make the data of much value. It seemed evident, however, that the animals in Group II, getting only one-fourth feed of alfalfa hay and all the sunflower silage they could handle to make up the roughage part of the ration, made a very unsatisfactory showing as they appeared to be getting an overfeed of sunflower silage. The lambs seemed to lack thrift and an excessive amount of urine was excreted, making the floor of the pen very wet. Groups III and IV showed irregularities in gain, which may have been due in part to the shortness of the period and the variation in the character of the lambs.

EXPERIMENTAL RESULTS

No changes in allotments were made at the end of the preliminary period although rather important changes were made in the rations fed. Group II, after being on alfalfa hay one-fourth feed, sunflower silage from frosted plants full feed, and three-quarter pound cracked corn for seven days, was changed to oat and pea silage because of decidedly unfavorable results from the sunflower silage. Group IV was put on oat and pea silage and the cracked corn allowance was increased for all groups to an average of about .75 pound per head per day. Results obtained are clearly shown in Table II and a number of interesting facts are brought out.

TABLE II

Oat and Pea Silage vs. Sunflower Silage for Fattening Lambs.

December 10, 1920, to February 18, 1921—70 Days.

	Group I Alfalfa Hay Cracked Corn lbs.	Group II Alfalfa Hay, Sil. Cracked Corn lbs.	Group III Alfalfa Sunf'r Sil. Cracked Corn lbs.	Group IV Alfalfa Oat & Pea Sil. Cr'd Corn lbs.
Average initial weight	70.28	63.13*	66.08	67.36
Average final weight	91.55	80.39	86.09	85.73
Total gain per lamb	21.27	17.26	20.01	18.37
Average daily gain—lbs.	.30	.25	.29	.26
Average daily feed:				
Alfalfa hay	2.00	.52	1.00	1.00
Sunflower or oat and pea silage		1.88**	1.19	1.19
Cracked corn	.79	.82	.79	.79
Feed consumed per 100 lbs. gain:				
Alfalfa hay	658.30	211.18	349.77	380.99
Sunflower or oat and pea silage		760.81	415.88	452.12
Cracked corn	260.41	334.15	276.72	301.42
Total	918.71	1306.14	1042.37	1134.53
Dry matter consumed per 100 lbs. gain	851.61	729.13	669.16	770.62
Daily feed cost	$00.036	$00.032	$00.032	$00.032
Feed cost of 100 lbs. gain	$11.84	$12.86	$11.28	$12.28

*These figures are based on 24 lambs. Two died while the lot was on the heavy feed of frosted sunflowers and but one lamb was substituted.

**Sunflower silage from frosted plants was fed during the first seven days only. It was then replaced by oat and pea silage.

FEED PRICES: Alfalfa hay, $17.00; Cracked corn, $48.00; Sunflower silage, $8.00; Oat and pea silage, $8.00.

Table II shows that check Group I went into the experiment with more weight than the other groups. Group II, that had previously been on a heavy silage ration, averaged nearly seven pounds less per lamb than Group I at the beginning of the experiment proper. Groups III and IV were rather close in average weight and some 3.5 pounds lighter per lamb than check Group I. After seventy days feeding, Group I still led with an average weight of 91.55 pounds. Group III stood second, averaging 86.09 pounds, showing that they had outgained Group IV. Group IV averaged 85.73 pounds while the heavy silage-fed lambs, Group II, averaged only 80.39 pounds. The average daily gains are very satisfactory. Check Group I holds a slight margin over the other groups having gained .30 pound per head daily. The relation between the sunflower silage-fed group and the oat and pea silage-fed group is interesting. The group on sunflower silage averaged .29 pound, while the group on oat and pea silage averaged only .26 pound. Group II received sunflower silage made from frosted plants during the first seven days of the experiment. At this time the lambs were falling off badly and two died, presumably from the effects of the heavy frosted silage allowance. Oat and pea silage was then substituted and the lambs did very well until the close of the experiment. The average daily gain in this group is practically the same as for Group IV where more hay and less silage was fed.

The figures showing the average daily feed eaten per lamb indicate that Group II consumed more silage than either III or IV that were getting twice as much hay. At the time they were changed to oat and pea silage they showed some increase in silage consumption but still refused some of the silage offered.

The feed requirement per hundred pounds gain brings to light several facts. Check Group I required 658.3 pounds of alfalfa and 260.41 pounds of cracked corn for each hundred pounds increase. In Group II the hay requirement was reduced by the silage but the grain requirement was increased about 28 per cent. The hay and silage requirements of groups III and IV did not vary widely but the differences in both cases were in favor of the sunflower silage-fed group. The corn requirement was also about 9 per cent less for the sunflower silage group. Comparing Group II with check Group I, 760.81 pounds of silage (largely oat and pea) replaced 447.12 pounds of alfalfa hay but caused an increased corn consumption of about 28 per cent. Based on the ration of corn consumed to hay consumed by check Group I, this increased corn consumption would probably be equivalent to 185 pounds of hay. By subtracting the 185 pounds from 447.12 pounds, we get 262.12 pounds as approximately the amount of hay replaced in Group III by 760.81 pounds of silage. In this group 2.9 pounds of silage equals one pound of alfalfa hay. In a similar manner comparing Group III with check Group I, we find that 415.88 pounds of sunflower silage replaced about 349.5 pounds of alfalfa hay, making 1.2 pounds of sunflower silage equal to one pound of alfalfa hay. In Group IV, 452.12 pounds of oat and pea silage replaced about 380 pounds of alfalfa hay, giving 1.2 pounds of oat and pea silage equal to one pound of alfalfa hay. With alfalfa hay worth $17, the mixed silage, fed Group II, was worth $5.86; the sunflower silage, fed Group III, was worth $14.17; and the oat and pea silage, fed Group IV, was worth $14.17 per ton.

In dry matter consumed per hundred pounds gain Group III, fed sunflower silage, shows a rather marked advantage over the other groups. This fact further indicates the high feeding value of the nutrients in sunflower silage as compared with alfalfa hay or oat and pea silage. This fact indicates that lambs can efficiently utilize a certain proportion of sunflower silage. The dry matter requirement of the group getting oat and pea silage is less than that of the check group and greater than that of the heavy silage-fed group.

Average daily feed costs do not vary widely. The use of silage did reduce daily feed costs to a slight extent with the feed prices used. There was no saving in offering the lambs less than half a feed of hay because they would not eat more silage than they consumed on a half feed of alfalfa hay.

In feed cost of 100 pounds gain the sunflower silage group stood first with a cost of $11.28; the check group stood second with a cost of $11.84; the oat and pea silage group third with $12.28; and the heavy silage group fourth with a cost of $12.86. From the economy standpoint sunflower silage proved slightly superior to oat and pea silage. Cheaper gains were secured by its use to replace half the alfalfa than by using alfalfa as the sole roughage. Oat and pea silage can replace half the hay but not more than half the hay.

At the close of the experiment no marked difference could be noted in the finish of the lambs in Groups I, III, and IV. Group II was somewhat lighter and less finished than the other three groups. These 88 lambs were fed hay for three days and then shipped to the Denver market. The lambs sold for $8.00 net and shrank 6.08%. There was a marked variation in finish and weight of individuals but the commission firm reported that sorting would not have increased the total sale value.

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SUMMARY

Two years' work comparing oat and pea silage with sunflower silage for fattening lambs indicates that half the normal amount of either native or alfalfa hay may be economically replaced by silage without affecting the rate of gain.

Lambs getting sunflower silage showed an average daily gain of .20 and .29 pound, respectively, for the two years.

Lambs getting oat and pea silage showed an average daily gain of .25 and .26 pound respectively, for the two years.

Sunflower silage and oat and pea silage show almost identical feeding values on a dry matter basis.

Sunflower silage made from plants frosted in the field proved satisfactory in replacing half the hay.

Heavier gains were secured when alfalfa hay furnished the major portion of the protein than when cottonseed meal or old process linseed meal were fed and native hay was used as roughage.

Linseed oil meal was not as satisfactory as cottonseed meal when both were fed with Wyoming native hay.

In replacement value 3.8 pounds of sunflower silage replaced one pound of native hay and 2.3 pounds of oat and pea silage replaced one pound of native hay.

In the second trial 1.2 pounds of sunflower silage replaced one pound of alfalfa hay and 1.2 pounds of oat and pea silage replaced one pound of alfalfa hay.

Rations of alfalfa hay and either sunflower or oat and pea silage with cracked corn seem to be more satisfactory than rations of Wyoming native hay, silage, and cottonseed or linseed meal.

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